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# SHORE-ZONE FISHES OF THE VICINITY OF FIRE ISLAND INLET, GREAT SOUTH BAY, NEW YORK[1]

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ABSTRACT

In 1970 and 1971, during the summer and fall, 57 species of fish were seined in the vicinity of Fire Island Inlet. The Atlantic silverside was the most numerous and most frequently caught fish, followed by the northern pipefish, although greater numbers of other species were seined. Observations of several species of interest due to either their rarity or unusual abundance are treated separately. Among the factors that appeared to influence the abundance and distribution of shore-zone fishes in the area were bottom type and vegetative cover, the nearness of the Atlantic Ocean and wind velocity.

In 1970 and 1971, during the summer and fall, seining operations were conducted at two sites in the vicinity of Fire Island Inlet, Great South Bay (Figure 1).

The site near the Fire Island Lighthouse had a hard-packed sand bottom that sloped gradually from shore, and the maximum depth

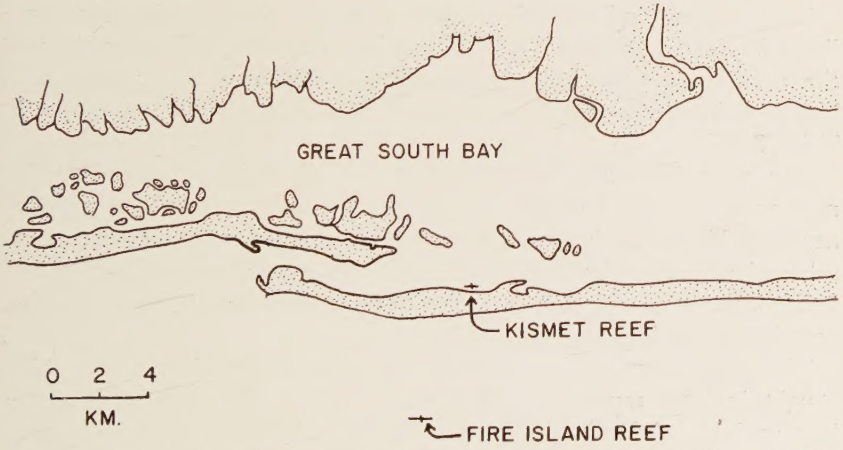


Figure 1. Map of vicinity of Fire Island Inlet showing seining sites near Fire Island Lighthouse (1) and at base of the Sore Thumb (2).

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reached by the seine at high water was about 1.2 meters. Eelgrass (*Zostera marina*) grew in scattered patches throughout this area. The most prominent algae were *Cladophora gracilis* which was abundant in July and August, and sea lettuce (*Ulva lactuca*) which was present in varying amounts from June through November.

The other site, at the base of a man-made rock and sand spit known as the Sore Thumb, also had a hard-packed sand bottom near shore. However, this quickly graded into a soft, muddy-sand bottom which sloped gradually for approximately 15 meters and then dropped off sharply. The maximum depth reached by the seine at high water was about 3 or 4 meters.

## METHODS

The 91.4-meter seine described in Briggs and O'Connor (1971) was set at each site in the same manner reported in that paper on 13 dates from July through November, 1970 and on 19 dates from June through November in 1971.

Captured fish were identified and the number of each species was recorded. However, if an unusually large group (more than 500) of any one species was caught, the number of individuals was estimated. Rare or uncommon fishes were preserved and taken to the laboratory for identification and for measurement to fork or total length (in millimeters) depending upon the conformation of the tail.

Temperature and salinity were recorded at each site in the same manner as described in Briggs and O'Connor (1971).

## FINDINGS

The common and scientific names of the 57 species of fish seined are listed by family in Table 1. The numbers of each species caught and the number of seine hauls in which they appeared are presented in Table 2. Water temperatures and salinities at each site are given in Table 3.

The most frequently caught species was the Atlantic silverside. The next most frequently caught fishes were (in order): northern pipefish, northern kingfish, winter flounder, mummichog, northern puffer, four-spine stickleback, Atlantic needlefish, Atlantic menhaden, bluefish, striped killifish, silver perch, tautog, white mullet, weakfish, Atlantic tomcod, permit, crevalle jack and bay anchovy.

The most abundant species was the Atlantic silverside. Other fishes caught in large numbers (500 or more individuals) were (in order): bay anchovy, Atlantic menhaden, northern kingfish, northern puffer, northern pipefish, silver perch and winter flounder.

Most of the fish taken, of nearly all species, were caught from July through October. However, three species were caught only early in the

TABLE 1. COMMON AND SCIENTIFIC NAMES, GROUPED BY FAMILY, OF SPECIES OF FISH COLLECTED BY SEINING IN THE VICINITY OF FIRE ISLAND INLET IN 1970 AND 1971

| Family and common name | Scientific name |
|---|---|
| Dasyatidae | |
| Roughtail stingray | *Dasyatis centroura* |
| Anguillidae | |
| American eel | *Anguilla rostrata* |
| Clupeidae | |
| Blueback herring | *Alosa aestivalis* |
| Hickory shad | *Alosa mediocris* |
| Alewife | *Alosa pseudoharengus* |
| Atlantic menhaden | *Brevoortia tyrannus* |
| Atlantic herring | *Clupea harengus harengus* |
| Round herring | *Etrumeus teres* |
| Engraulidae | |
| Striped anchovy | *Anchoa hepsetus* |
| Bay anchovy | *Anchoa mitchilli* |
| Gadidae | |
| Atlantic tomcod | *Microgadus tomcod* |
| Pollock | *Pollochius virens* |
| Exocoetidae | |
| Halfbeak | *Hyporhamphus unifasciatus* |
| Belonidae | |
| Atlantic needlefish | *Strongylura marina* |
| Cyprinodontidae | |
| Sheepshead minnow | *Cyprinodon variegatus* |
| Mummichog | *Fundulus heteroclitus* |
| Striped killifish | *Fundulus majalis* |
| Atherinidae | |
| Rough silverside | *Membras martinica* |
| Tidewater silverside | *Menidia beryllina* |
| Atlantic silverside | *Menidia menidia* |
| Gasterodteidae | |
| Fourspine stickleback | *Apeltes quadracus* |
| Threesprine stickleback | *Gasterosteus aculeatus* |
| Syngnathidae | |
| Lined seahorse | *Hippocampus erectus* |
| Northern pipefish | *Syngnathus fuscus* |
| Pomatomidae | |
| Bluefish | *Pomatomus saltatrix* |
| Carangidae | |
| Blue runner | *Caranx chrysos* |
| Crevalle jack | *Caranx hippos* |
| Bigeye scad | *Selar crumenophthalmus* |
| Lookdown | *Selene vomer* |
| Banded rudderfish | *Seriola zonata* |
| Florida pompano | *Trachinotus carolinus* |
| Permit | *Trachonotus falcatus* |
| Sparidae | |
| Pinfish | *Lagodon rhomboides* |
| Scup | *Stenotomus chrysops* |
| Sciaenidae | |
| Silver perch | *Bairdiella chrysura* |
| Weakfish | *Cynoscion regalis* |
| Northern kingfish | *Menticirrhus saxatilis* |

Table 1. (*Continued*)

| Family and common name | Scientific name |
|---|---|
| Mullidae | |
| Red goatfish | *Mullus auratus* |
| Labridae | |
| Tautog | *Tautoga onitis* |
| Cunner | *Tautogolabrus adspersus* |
| Mugilidae | |
| Striped mullet | *Mugil cephalus* |
| White mullet | *Mugil curema* |
| Sphyraenidae | |
| Northern sennet | *Sphyraena borealis* |
| Ammodytidae | |
| American sand lance | *Ammodytes americanus* |
| Acanthuridae | |
| Doctorfish | *Acanthurus chirurgus* |
| Scombridae | |
| Atlantic mackerel | *Scomber scombrus* |
| Stromateidae | |
| Butterfish | *Peprilus triacanthus* |
| Triglidae | |
| Northern searobin | *Prionotus carolinus* |
| Striped searobin | *Prionotus evolans* |
| Cottidae | |
| Grubby | *Myoxocephalus aenaeus* |
| Dactylopteridae | |
| Flying gurnard | *Dactylopterus volitans* |
| Bothidae | |
| Windowpane | *Scophthalmus aquosus* |
| Pleuronectidae | |
| Winter flounder | *Pseudopleuronectes americanus* |
| Balistidae | |
| Orange filefish | *Aluterus schoepfi* |
| Planehead filefish | *Monacanthus hispidus* |
| Ostraciidae | |
| Smooth trunkfish | *Lactophrys triqueter* |
| Tetraodontidae | |
| Northern puffer | *Sphoeroides maculatus* |

seining season. All the Atlantic herring and pollock were caught in June. All the Atlantic mackerel were caught in June or early July.

Species that were caught in greater numbers at the Lighthouse than at the Sore Thumb included: Atlantic silverside (in 1971), northern pipefish, northern puffer, northern kingfish, silver perch, weakfish (in 1970), winter flounder, fourspine stickleback, bluefish, Atlantic needlefish, American sand lance (in 1971), pollock, tautog, mummichog (in 1971), northern searobin and Atlantic tomcod.

Species that were caught in greater numbers at the Sore Thumb than at the Lighthouse included Atlantic silverside (in 1970), bay anchovy, Atlantic menhaden, striped killifish, permit, weakfish (in 1970), blueback

herring, white mullet, Atlantic mackerel, Atlantic herring and crevalle jack.

Certain species were of interest due to either their unusual abundance or their rarity. Observations on these species were treated separately.

### ROUGHTAIL STINGRAY

This species, potentially dangerous to man, was seined at the Lighthouse on August 5, 1970. The one specimen caught was small, being only about 30 millimeters long. Although it is rarely captured in Great South Bay, Schaefer (1967) found the species to be common in the surf zone of the barrier beach.

### ROUND HERRING

One round herring was seined at the Sore Thumb on July 15, 1971, and 20 were taken at the Lighthouse on July 23, 1971. They ranged from 98 to 115 millimeters in fork length. Although not uncommon in the oceanic waters of Long Island, this species is rare in the south shore bays.

### STRIPED ANCHOVY

Five adults were seined at the Sore Thumb on June 19, 1971 and 14 larvae were collected at that site on September 19, 1971. The adults were 60, 65, 68, 72 and 75 millimeters in fork length. The larvae ranged from 32 to 39 millimeters in fork length and averaged 35 millimeters. This is another fish more common to the oceanic waters than to the south shore bays of Long Island.

### BAY ANCHOVY

Although this species was not frequently taken, large numbers were seined in just a few hauls. The bay anchovy cannot be considered rare or uncommon, but it seems worthy of note that strong winds were apparently a factor in making the species available to the seine. On October 16, 1970, northeast winds blew at about 20 knots when 1,000 were captured at each site. Field notes show "strong easterly" winds on October 21, 1970 when 1,500 bay anchovies were seined at the Sore Thumb. Winds were strong from the northeast on June 9, 1971 and strong from the west (20 to 30 knots) on November 4, 1971 when nearly all the bay anchovies collected that year were caught at the Sore Thumb.

### HALFBEAK

One halfbeak, 105 millimeters in fork length, was caught at the Lighthouse on October 21, 1970. Alperin and Schaefer (1965) reviewed occurrences of this locally rare fish.

Table 2. Number of Fish Caught and Number of Seine Hauls in Which They Appeared For Species Taken Near the Fire Island Lighthouse and Near the Sore Thumb

| Species | 1970 | | 1971 | |
|---|---|---|---|---|
| | Number of fish | Number of hauls | Number of fish | Number of hauls |
| **Fire Island Lighthouse** | | | | |
| Atlantic silverside | 2,512 | 13 | 29,156 | 19 |
| Northern pipefish | 444 | 12 | 1,036 | 18 |
| Northern puffer | 68 | 4 | 1,252 | 11 |
| Northern kingfish | 445 | 10 | 828 | 13 |
| Bay anchovy | 1,002 | 3 | 0 | 0 |
| Silver perch | 263 | 8 | 360 | 10 |
| Weakfish | 311 | 7 | 157 | 5 |
| Winter flounder | 202 | 10 | 211 | 15 |
| Fourspine stickleback | 80 | 7 | 324 | 16 |
| Bluefish | 269 | 8 | 80 | 9 |
| Atlantic needlefish | 151 | 7 | 144 | 11 |
| American sand lance | 0 | 0 | 188 | 4 |
| Pollock | 0 | 0 | 184 | 3 |
| Atlantic menhaden | 13 | 3 | 130 | 6 |
| Tautog | 15 | 6 | 90 | 12 |
| Mummichog | 5 | 5 | 83 | 14 |
| Northern searobin | 28 | 4 | 44 | 5 |
| Striped searobin | 0 | 0 | 33 | 4 |
| Atlantic tomcod | 17 | 8 | 13 | 4 |
| White mullet | 21 | 2 | 5 | 2 |
| Striped killifish | 3 | 2 | 19 | 6 |
| Round herring | 0 | 0 | 20 | 1 |
| Cunner | 7 | 3 | 6 | 3 |
| Grubby | 5 | 5 | 8 | 3 |
| Striped mullet | 6 | 2 | 6 | 1 |
| American eel | 6 | 5 | 5 | 2 |
| Threespine stickleback | 0 | 0 | 7 | 2 |
| Alewife | 6 | 3 | 0 | 0 |
| Hickory shad | 6 | 2 | 0 | 0 |
| Banded rudderfish | 5 | 1 | 0 | 0 |
| Planehead filefish | 1 | 1 | 1 | 1 |
| Red goatfish | 1 | 1 | 1 | 1 |
| Atlantic mackerel | 0 | 0 | 2 | 2 |
| Roughtail stingray | 1 | 1 | 0 | 0 |
| Halfbeak | 1 | 1 | 0 | 0 |
| Flying gurnard | 1 | 1 | 0 | 0 |
| Rough silverside | 0 | 0 | 1 | 1 |
| Permit | 0 | 0 | 1 | 1 |
| Blueback herring | 0 | 0 | 1 | 1 |
| Orange filefish | 0 | 0 | 1 | 1 |
| Pinfish | 0 | 0 | 1 | 1 |
| Lined seahorse | 0 | 0 | 1 | 1 |
| **Sore Thumb** | | | | |
| Atlantic silverside | 4,331 | 11 | 13,608 | 18 |
| Bay anchovy | 2,500 | 2 | 5,567 | 5 |
| Atlantic menhaden | 72 | 5 | 5,769 | 10 |
| Northern kingfish | 128 | 9 | 624 | 9 |
| Northern puffer | 11 | 4 | 508 | 9 |
| Striped killifish | 154 | 5 | 167 | 8 |
| Permit | 21 | 2 | 258 | 8 |
| Weakfish | 39 | 1 | 178 | 3 |
| Blueback herring | 2 | 2 | 184 | 5 |

TABLE 2. (*Continued*)

| Species | 1970 | | 1971 | |
|---|---|---|---|---|
| | Number of fish | Number of hauls | Number of fish | Number of hauls |
| White mullet | 149 | 6 | 33 | 9 |
| Winter flounder | 1 | 1 | 139 | 8 |
| Bluefish | 108 | 5 | 17 | 2 |
| Striped searobin | 0 | 0 | 120 | 5 |
| Atlantic mackerel | 0 | 0 | 95 | 4 |
| Mummichog | 47 | 3 | 32 | 8 |
| Northern pipefish | 10 | 8 | 68 | 10 |
| Atlantic herring | 0 | 0 | 69 | 1 |
| Atlantic needlefish | 17 | 2 | 21 | 5 |
| American sand lance | 18 | 3 | 0 | 0 |
| Crevalle jack | 10 | 5 | 10 | 6 |
| Striped anchovy | 0 | 0 | 19 | 2 |
| Sheepshead minnow | 18 | 3 | 0 | 0 |
| Planehead filefish | 7 | 1 | 3 | 2 |
| Striped mullet | 8 | 3 | 1 | 1 |
| Lined seahorse | 1 | 1 | 4 | 1 |
| Fourspine stickleback | 2 | 1 | 2 | 2 |
| Tautog | 0 | 0 | 4 | 2 |
| Scup | 2 | 2 | 1 | 1 |
| Butterfish | 2 | 2 | 1 | 1 |
| Threespine stickleback | 0 | 0 | 3 | 2 |
| Florida pompano | 0 | 0 | 3 | 3 |
| Northern sennet | 0 | 0 | 3 | 2 |
| Windowpane | 1 | 1 | 1 | 1 |
| Silver perch | 2 | 1 | 0 | 0 |
| Blue runner | 2 | 1 | 0 | 0 |
| Bigeye scad | 1 | 1 | 0 | 0 |
| Round herring | 0 | 0 | 1 | 1 |
| Tidewater silverside | 0 | 0 | 1 | 1 |
| Lookdown | 0 | 0 | 1 | 1 |
| Doctorfish | 0 | 0 | 1 | 1 |
| Smooth trunkfish | 0 | 0 | 1 | 1 |

### ROUGH SILVERSIDE

One rough silverside, 82 millimeters in fork length, was seined at the Lighthouse on June 9, 1971. None of the records cited by Alperin and Schaefer (1965) placed this species in Great South Bay.

### JACKS

In total, jacks (Carangidae) contributed more species to the catch than any other family. Although not common, juvenile jacks were considered regular summer visitors to the waters of Long Island by Alperin (1967). The following juvenile jacks were seined: blue runner, two at the Sore Thumb on October 16, 1970; crevalle jack, 10 each year at the Sore Thumb; bigeye scad, one at the Sore Thumb on August 5, 1971; lookdown, one of 42 millimeters in fork length at the Sore Thumb on July 23, 1971; banded rudderfish, a group of five about 200 millimeters in fork length at the Lighthouse on August 11, 1970; Florida pompano, one of 26 millimeters in fork length on July 30, 1971, one of 64 milli-

Table 3. Water Temperatures and Salinities on the Dates When Collections Were Made at the Fire Island Lighthouse and Sore Thumb Sites

| 1970 | | | 1971 | | |
|---|---|---|---|---|---|
| Date | Temperature* | Salinity§ | Date | Temperature* | Salinity§ |
| **Fire Island Lighthouse** | | | | | |
| July 22 | .. | .. | June 9 | .. | .. |
| 29 | 22.2 | 27.0 | 17 | 18.3 | 29.4 |
| August 5 | 18.9 | 30.8 | 23 | 20.6 | 28.6 |
| 12 | 21.1 | 27.4 | July 1 | 22.8 | 28.0 |
| 19 | 21.1 | 30.0 | 9 | 24.4 | 30.0 |
| 26 | 21.1 | 27.0 | 15 | 22.8 | 27.0 |
| September 10 | 18.9 | 28.8 | 23 | 23.3 | 29.0 |
| 23 | 21.1 | 28.0 | 30 | 24.4 | 27.8 |
| October 9 | 16.1 | 29.6 | August 6 | 22.2 | 28.0 |
| 16 | 13.9 | 31.0 | 13 | 22.8 | 27.4 |
| 21 | 12.2 | 31.6 | 20 | 25.0 | 27.0 |
| 28 | 7.8 | 30.0 | 30 | 23.3 | 28.0 |
| November 6 | 7.8 | 31.0 | September 10 | 22.8 | 29.0 |
| | | | 17 | 24.4 | 26.2 |
| | | | 24 | .. | .. |
| | | | 29 | 18.9 | 28.4 |
| | | | October 21 | 15.0 | 29.0 |
| | | | November 4 | .. | .. |
| | | | 10 | 10.6 | .. |
| **Sore Thumb** | | | | | |
| July 22 | .. | .. | June 9 | .. | .. |
| 29 | 20.0 | 29.6 | 17 | 19.4 | 29.0 |
| August 5 | 23.3 | 28.6 | 23 | 21.1 | 28.0 |
| 12 | 20.6 | 29.2 | July 1 | † | † |
| 19 | 23.3 | 28.2 | 9 | 26.1 | 28.0 |
| 26 | 21.1 | 28.8 | 15 | 23.3 | 28.4 |
| September 10 | 18.9 | 29.2 | 23 | 24.4 | 29.0 |
| 23 | 20.0 | 30.0 | 30 | 23.3 | 28.4 |
| October 9 | 16.1 | 29.0 | August 6 | 22.8 | 28.0 |
| 16 | 14.4 | 29.0 | 13 | 24.4 | 27.0 |
| 21 | 11.1 | 31.6 | 20 | 23.9 | 27.8 |
| 28 | 10.0 | 30.4 | 30 | 21.1 | 28.4 |
| November 6 | 8.9 | 30.8 | September 10 | 23.3 | 30.0 |
| | | | 17 | 24.4 | 26.0 |
| | | | 24 | .. | .. |
| | | | 29 | 19.4 | 28.4 |
| | | | October 21 | 14.4 | 28.6 |
| | | | November 4 | .. | .. |
| | | | 10 | 10.6 | .. |

* In degrees Celsius.
§ In parts per thousand.
† No fish caught or data recorded because of damaged net.

meters on September 10, 1971 and one of 62 millimeters on September 29, 1971, all at the Sore Thumb; permit, 280, all but one at the Sore Thumb. Permit were seined on 11 occasions from early August through late September. As many as 213 were caught in a single haul (September 10, 1971). Permit ranged from 27 to 40 millimeters in fork length in

August and from 36 to 51 millimeters in September. Alperin and Schaefer (1965) and Briggs (1970) considered the permit rare in New York waters. However, the rather frequent occurrences of the species tend to indicate that it may not be as scarce locally as previously thought.

### PINFISH

One pinfish, 49 millimeters in fork length, was caught at the Lighthouse on August 6, 1971 (Figure 2). This sparid was considered rare

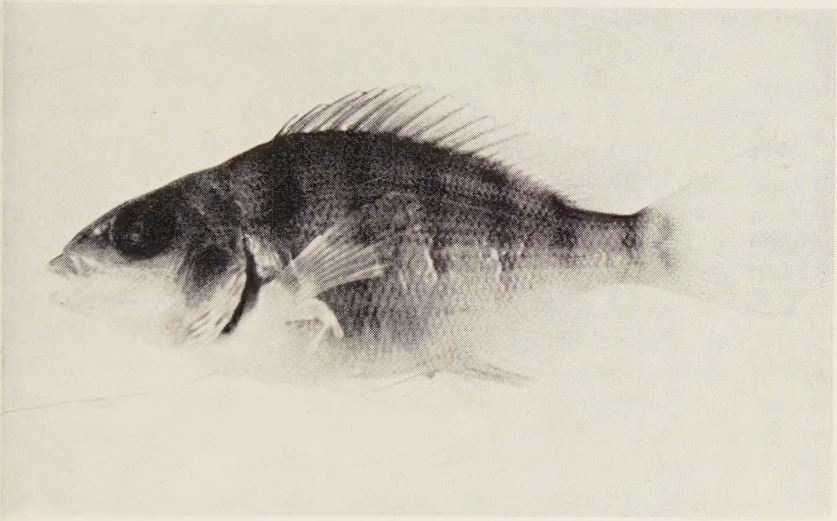

Figure 2. Pinfish seined near Fire Island Lighthouse on August 6, 1971.

to occasional by Nichols (1918) and Nichols and Breder (1927). Greeley (1939) found the species in only three collections.

### RED GOATFISH

Two red goatfish were caught at the Lighthouse, one of 54 millimeters in fork length on July 29, 1970 and one of 88 millimeters on August 30, 1971. Alperin and Schaefer (1965) reviewed the records of this locally rare fish.

### DOCTORFISH

One doctorfish, 41 millimeters in fork length, was caught at the Sore Thumb on June 23, 1971 (Figure 3). This appears to be the first record of the species from Great South Bay and only the fourth from all the waters of Long Island, three earlier records having been cited by Alperin and Schaefer (1965).

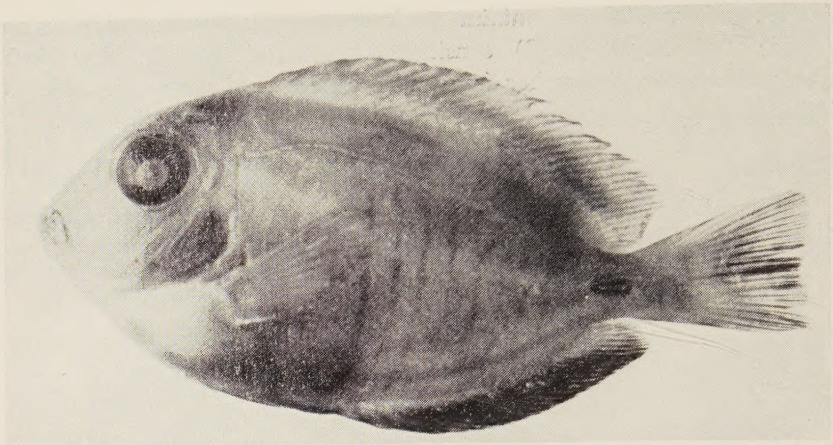

Figure 3. Doctorfish seined at base of the Sore Thumb on June 30, 1971.

### Flying Gurnard

One flying gurnard, 241 millimeters in fork length, was caught at the Lighthouse on November 6, 1970. Alperin and Schaefer (1965) listed only 12 records of the species from the south shore. This specimen appears to be the largest recorded from Long Island waters.

### Smooth Trunkfish

One smooth trunkfish, 10 millimeters in total length, was caught at the Sore Thumb on July 30, 1971. Although Alperin and Schaefer (1965) and Briggs (1970) recorded a single specimen each, Greeley (1939) reported about 70 between 8 and 16 millimeters long from Fire Island Inlet. The only other smooth trunkfish from Long Island waters was collected by Latham at Orient and reported in Alperin and Schaefer (1965).

## DISCUSSION

Several of the species caught in greater numbers at the Lighthouse than at the Sore Thumb were among those that Briggs and O'Connor (1971) found to prefer naturally vegetated areas. In this category were: northern pipefish, silver perch, pollock, winter flounder, Atlantic needlefish, fourspine stickleback, tautog, mummichog (in 1971) and Atlantic tomcod. On the other hand, Atlantic silverside (in 1971) and northern kingfish were also more numerous at the Lighthouse than at the Sore Thumb. Briggs and O'Connor (1971) found those two species to prefer sand-filled areas. Most likely, the seining site at the Lighthouse with its scattered patches of eelgrass growing in hard-packed sand was interme-

diate between the naturally vegetated and sand-filled sites described by Briggs and O'Connor.

The seining site at the Sore Thumb was a sand-filled area and, in general, it harbored a similar collection of fishes as the sand-filled areas described by Briggs and O'Connor (1971). For example, Atlantic silverside (in 1970), white mullet and striped killifish, which Briggs and O'Connor found to prefer sand-filled areas, were more numerous at the Sore Thumb than at the Lighthouse. However, bay anchovy, Atlantic herring and blueback herring were also more numerous at the Sore Thumb than at the Lighthouse. Briggs and O'Connor found those species to prefer naturally vegetated areas. Other factors than a preference for a certain bottom type or vegetative cover must have influenced their distribution in the Fire Island Inlet area of Great South Bay. It appears that the distribution of the bay anchovy in shore-zone areas of Fire Island Inlet, and perhaps all of Great South Bay, may be strongly influenced by wind velocity. Strong winds producing rough water and temporarily strong currents may be able to force the species into areas where it might not be ordinarily found in abundance. The Atlantic herring were all juveniles and were all caught in a single haul of the seine on June 9, 1971. If naturally vegetated areas of Great South Bay serve as nursery grounds for the species in the spring, as suggested by Briggs and O'Connor (1971), then those caught at the Sore Thumb may have been in the process of leaving the bay for the ocean as the waters warmed with the approach of summer. The conclusions about blueback herring preferring naturally vegetated areas may not have been based on a large enough sample (only 19 fish) or perhaps those caught at the Sore Thumb were taken by chance.

The nearness of the Atlantic Ocean to the seining sites was most likely a factor in the finding of so many carangid and other uncommon species. Likewise the nearness of the ocean was probably a factor in the finding of large numbers of juvenile Atlantic mackerel and lesser numbers of other more or less oceanic species such as round herring, striped anchovy, scup and butterfish.

It appears that among the factors that determined the distribution and abundance of shore-zone fishes in the vicinity of Fire Island Inlet in 1970 and 1971 were the bottom type and vegetative cover, the nearness of the Atlantic Ocean and, at least for the bay anchovy, wind velocity.

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# ROLE OF CAMPS IN RELATION TO DEER HUNTING IN THE TOWN OF MALONE[1]

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ABSTRACT

A survey was made of all camps in the Town of Malone to determine their ownership and the uses made of them, particularly with respect to deer hunting. Insofar as possible, all deer taken in the town from 1968 to 1972, whether legally or illegally, were recorded. Of the 173 camps present in 1972, there were 105 on Lake Titus and 68 elsewhere in the town. Thirty-three camps had been used for deer hunting, most of those still used for that purpose being located away from Lake Titus. Fishing, alone or in combination with activities other than hunting, accounted for over half of all camp uses. Of all camp owners, 48 per cent travelled less than 11 miles from home to camp, and deer hunters travelled fewer miles than others. Nearly two-thirds of the camps used for deer hunting were owned by residents of the town, and most of the deer taken each year were taken by residents of the Town of Malone or adjoining towns. Although 27 per cent of all deer taken during the study period were the result of camp-related hunting, such hunting decreased markedly during those years. Also, the incidence of illegally taken deer decreased substantially in total and dropped to zero with respect to camp hunting.

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The Town of Malone in Franklin County is representative of the peripheral Adirondacks where deer populations have been extremely low for many years. From 1968 to 1972, an investigation was carried on to assess the factors involved. The nature of the deer range was described by Jackson (1974). Preliminary observations indicated that much of the deer hunting in the town was associated with hunting camps. Accordingly, efforts were made to locate all camps in the town and determine their ownership and the uses made of them, particularly with respect to deer hunting.

## METHODS

Project personnel included two special game protectors. During the fall of 1968, they checked all camps encountered on their routine patrols. Whenever the owner (or lessee) was present, he was interviewed. Information was recorded on a standard form and included the owner's name and address, camp acreage and use (hunting, fishing or other). Whether hunting involved deer or small game, or both, was noted. The residence of all hunters using the camp was also recorded. Each

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[1]A contribution of Federal Aid in Fish and Wildlife Restoration Project W-89-R. Particular thanks are due Special Game Protectors Stanley Stickles and Lyndon Raville who worked throughout the study making interviews and compiling data on the camps and their owners as well as documenting deer killed in the Town of Malone. David Harwood, a student at North Country Community College in Saranac Lake, also assisted in collecting camp data during the summer of 1972 and helped bring the survey to a close.

camp was given an identification number which was also pinpointed on a topographic map of the town.

However, the owner was seldom present when a camp was visited and during the fall of 1970 return-addressed postcards covering the essential information desired were placed under the doors of 10 known hunting camps. Only three partially completed cards were returned, and this method was dropped.

All camps in the town were located between 1968 and 1970, except those on Lake Titus where over half the total were situated. Owners of camps on Lake Titus were generally in residence during the summer, particularly on holiday weekends, and an intensive effort to contact them was made during the summer of 1971. Special Game Protector Raville was able to obtain the owners' names and addresses and camp acreages from the records of the Lake Titus Protective Association, and he and Special Game Protector Stickles proceeded to interview them. The survey was conducted by motorboat since most camps were accessible only by water. Visits were made primarily on weekends when the owners were most likely to be in residence, and the survey was completed during the summer.

After the success of the Lake Titus survey, it was decided to make a similar survey of the remaining camps in the town for which information was lacking. This was done by a college student during the summer of 1972. But, unlike those at Lake Titus, these camp owners were not generally in residence in summer, and the procedure was modified. The owners' names and addresses were obtained from the town clerk's office, tax assessment rolls, the voter registration list and posters on the camp properties. At the same time, previous records were updated with respect to new camps that had been built and former camps no longer used as such. This resulted in a list of the owners of all camps for which data were still needed. To each of these was mailed a letter of explanation and an information leaflet concerning the over-all study of deer in the Town of Malone, together with a return-addressed postcard covering the information desired. A week later, a follow-up letter was mailed, and a week after that personal telephone contacts were made.

Following the 1972 summer survey, only a few camps remained for which data were still needed. During the deer hunting season that fall, the two special game protectors visited these camps weekly. In this way, and by continued telephone effort, most of these remaining owners were finally contacted. A few, however, were never contacted, but partial information was often obtained from neighbors. Thus, in some categories in the tabulations, the total number of camps known to have existed is not represented.

During the deer hunting season, the special game protectors visited the known hunting camps frequently. They also patrolled throughout

the year and obtained as complete a record as possible of all deer taken in the Town of Malone, both legally and illegally. These records were differentiated as to whether or not camp-related hunting was involved.

## FINDINGS AND DISCUSSION

The total number of camps in the Town of Malone varied from year to year. New camps were continually being built, and established camps became permanent residences or were abandoned. Others were in various states of inactivity as a result of being for sale, death in the family or change in residence of the owner. The total number and their status from 1970 to 1972 are shown in Table 1. Since the camp survey was

Table 1. Number of Camps in Town of Malone and Their Status, 1970–1972

| Year | Active* | | | Inactive | Total |
|---|---|---|---|---|---|
| | Lake Titus | Elsewhere | Total | | |
| 1970 | 104 | 68 | 172 | 9 | 181 |
| 1971 | 104 | 69 | 173 | 0 | 173 |
| 1972 | 105 | 58 | 163 | 10 | 173 |

* Camp used at least once during year.

not completed until 1972, some of the data were obtained by direct observation by the special game protectors, hunter contacts during the hunting season and information from town authorities and neighbors.

The drop in the total number of camps between 1970 and 1971 was primarily due to eight being made into permanent homes. Camps on Lake Titus were more active and more stable, presumably because of the recreational aspect of camps on water. Also, the Lake Titus Protective Association keeps track of ownership, and when a camp is for sale a new owner is rapidly found. Lake Titus, about 5 miles long and nearly half a mile wide, lies in the southern part of the Town of Malone.

The information concerning the camps and their relation to deer hunting are discussed under several topics. Because of the generally more substantial character of the camps at Lake Titus, the data for them are tabulated separately in some cases.

### Camp Acreage

Camps in the Town of Malone occupied a minimum of 7,643.75 acres during this study. This represented 11.5 per cent of the land area of the town (66,752 acres). The camps at Lake Titus, mostly situated on 100x500-foot lots, comprised 188.25 acres for an average of 1.79 acres. The other camps are listed in Table 2 together with their acreages and notes on their status. Although the properties associated with these camps

Table 2. Acreage of Camp Properties in Town of Malone, Exclusive of Those at Lake Titus

| Camp No. | Acres | Camp No. | Acres |
|---|---|---|---|
| 1 | 304 | 36 | 1 |
| 2 | 304 | 37 | 0.5 |
| 3 | * | 38 | 1 |
| 4 | 0.5 | 39 | 1 |
| 5 | 0§ | 40 | 1 |
| 6 | † | 41 | 3 |
| 7 | 43 | 42 | 48 |
| 8 | 155 | 43 | 70+†† |
| 9 | 45 | 44 | 1,000 |
| 10 | * | 45 | 2,200 |
| 11 | 60 | 46 | 7.5 |
| 12 | 50 | 47 | 1.5 |
| 13 | 3 | 48 | 14 |
| 14 | † | 49 | 600 |
| 15 | 52 | 50 | 40 |
| 16 | ‡ | 51 | 65 |
| 17 | 147 | 52 | ‡‡ |
| 18 | 2 | 53 | 91 |
| 19 | 63 | 54 | 41 |
| 20 | 335 | 55 | 60 |
| 21 | 300 | 56 | 33 |
| 22 | 2 | 57 | ‡ |
| 23 | 6 | 58 | 5 |
| 24 | 150 | 59 | 102 |
| 25 | 100 | 60 | 1 |
| 26 | 2.5 | 61 | 144 |
| 27 | 0.5 | 62 | 170 |
| 28 | 52 | 63 | 79 |
| 29 | 2 | 64 | 115 |
| 30 | 2 | 65 | 110 |
| 31 | 26 | 66 | 9.5 |
| 32–34 | 70 | 67 | 134 |
| 35 | 1 | 68 | 30 |
| Total (61 camps) | | | 7,455.5 |

* Owner not located.
§ Transient bus.
† Owner refused information.
‡ Permanent residence.
†† Minimal (owner didn't know).
‡‡ Abandoned.

averaged 122.2 acres, they ranged from 0.5 to 2,200 acres. The total acreage shown (7,455.5) is minimal because figures for seven camps are not included. Camp acreage does not reflect hunting pressure because of variations in the number of hunters using the different camps and because in many cases, although the camp was used as headquarters, those occupying it hunted deer on adjacent State and private lands.

## Camp Use

Four use categories were included in the information compiled for each camp: small game hunting, deer hunting, fishing, and other recreation. The data are summarized in Table 3. Of the 15 possible combina-

Table 3. Uses of Camps in Town of Malone

| Use | Lake Titus | | Elsewhere* | | Total | |
|---|---|---|---|---|---|---|
| | Number | Per cent | Number | Per cent | Number | Per cent |
| Not deer-related | | | | | | |
| Fishing only | 8 | 7.6 | 0 | 0.0 | 8 | 4.9 |
| Recreation only | 28 | 26.7 | 29 | 50.0 | 57 | 35.0 |
| Fishing & recreation | 53 | 50.5 | 8 | 13.8 | 61 | 37.4 |
| Small game hunting & fishing | 2 | 1.9 | 0 | 0.0 | 2 | 1.2 |
| Small game hunting & recreation | 0 | 0.0 | 2 | 3.4 | 2 | 1.2 |
| Sub-total | 91 | 86.7 | 39 | 67.2 | 130 | 79.7 |
| Deer-related | | | | | | |
| Deer hunting only | 0 | 0.0 | 3 | 5.2 | 3 | 1.8 |
| Deer & small game hunting | 0 | 0.0 | 9 | 15.5 | 9 | 5.5 |
| Deer hunting & fishing | 3 | 2.9 | 1 | 1.7 | 4 | 2.5 |
| Deer hunting & recreation | 0 | 0.0 | 1 | 1.7 | 1 | 0.6 |
| Deer & small game hunting & fishing | 0 | 0.0 | 1 | 1.7 | 1 | 0.6 |
| Deer & small game hunting & recreation | 0 | 0.0 | 2 | 3.5 | 2 | 1.2 |
| Deer hunting, fishing & recreation | 6 | 5.7 | 2 | 3.5 | 8 | 4.9 |
| Deer & small game hunting, fishing & recreation | 5 | 4.7 | 0 | 0.0 | 5 | 3.2 |
| Sub-total | 14 | 13.3 | 19 | 32.8 | 33 | 20.3 |
| Total | 105 | 100.0 | 58 | 100.0 | 163 | 100.0 |

* Ten camps not included: six were inactive for various reasons; two had become permanent residences; one owner could not be contacted; one was abandoned.

tions of these uses, 13 were participated in by the camp owners and their guests.

Uses Related to Deer Hunting All eight of the options related to deer hunting were used, indicating that deer hunters were likely to engage in other activities either during the hunting season or at some other time of the year. Of the 163 camps for which use data were obtained, only 12 (7.3 per cent) were used solely for hunting and only three (1.8 per cent) were used exclusively for deer hunting. Camps at Lake Titus were used markedly less for deer hunting than were camps elsewhere. In fact, none of the 12 camps used solely for hunting was at Lake Titus. Furthermore, the camps away from Lake Titus tended to be used less and were more frequently inactive during the study period.

Of the 33 camps for which deer hunting was given as a use, seven were not used for this purpose during the years 1968 to 1972 (Table 4). Only 14 were used for deer hunting in 1972, only one of which was at

Table 4. Number of Camps Used For Deer Hunting in Town of Malone According to Last Year So Used

| Year | Number | | | Years since last used for deer hunting |
|---|---|---|---|---|
| | Lake Titus | Elsewhere | Total | |
| 1972 | 1 | 13 | 14 | 0 |
| 1971 | 2 | 3 | 5 | 1 |
| 1970 | 3 | 2 | 5 | 2 |
| 1969 | 2 | .. | 2 | 3 |
| 1968 | .. | .. | .. | .. |
| 1967 | 1 | .. | 1 | 5 |
| 1962–1966 | .. | .. | .. | .. |
| 1961 | .. | 1 | 1 | 10 |
| 1960* | 1 | .. | 1 | 11* |
| 1959* | 1 | .. | 1 | 12* |
| 1956–1958 | .. | .. | .. | .. |
| 1955* | 1 | .. | 1 | 16* |
| 1947–1954 | .. | .. | .. | .. |
| 1946 | 1 | .. | 1 | 26 |
| 1945 | .. | .. | .. | .. |
| 1944 | 1 | .. | 1 | 28 |

* Approximately.

Lake Titus. Many camp owners who ceased such hunting during the study period cited decreasing deer abundance as the reason.

Uses Not Related to Deer Hunting Only five of the seven options not related to deer hunting were used. However, such activities were the exclusive uses at 79.7 per cent of the camps (Table 3). Fishing and recreation was the use cited by 37.4 per cent of the camp owners, and recreation only was cited by 35.0 per cent; these two categories accounted for 72.4 per cent of all the camps in the town. In all, 126 camps (77.3 per cent) were not used for hunting of any sort.

## Relation of Camp to Residence of Owner

The owner's home address was included in the information recorded for each camp. From this the road distance from home to camp was determined. These data were analyzed to see if deer hunters travelled farther than other camp owners. Although place of residence and distance from camp were closely related, it was felt that certain socio-economic factors or political constraints might influence "from where" and "how far" owners would travel to camp. Therefore, the data were tabulated separately according to political subdivisions and distance categories.

Place of Residence The camp owner's place of residence was tabulated according to whether it was in the Town of Malone, elsewhere in New York State or outside the State. These data were further tabulated separately for the camps at Lake Titus and for those elsewhere in the Town of Malone according to whether or not the camp had been used for deer hunting (Table 5). Between the two groups of

Table 5. Distribution of Places of Residence of Owners of Camps in Town of Malone According to Whether or Not Camp Was Used For Deer Hunting

| Place of residence | Lake Titus | | | Elsewhere* | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Number | Percentage of | | Number | Percentage of | | Number | Percentage of | |
| | | Sub-total | Total | | Sub-total | Total | | Sub-total | Total |
| **Camps not used for deer hunting** | | | | | | | | | |
| Town of Malone | 46 | 50.5 | 43.8 | 28 | 60.9 | 43.1 | 74 | 54.0 | 43.5 |
| Elsewhere in New York State | 20 | 22.0 | 19.0 | 11 | 23.9 | 16.9 | 31 | 22.6 | 18.2 |
| Outside New York State | 21 | 23.1 | 20.0 | 6 | 13.0 | 9.2 | 27 | 19.7 | 15.9 |
| Unknown | 4 | 4.4 | 3.8 | 1 | 2.2 | 1.5 | 5 | 3.7 | 2.9 |
| Sub-total | 91 | 100.0 | 86.6 | 46 | 100.0 | 70.7 | 137 | 100.0 | 80.6 |
| **Camps used for deer hunting** | | | | | | | | | |
| Town of Malone | 9 | 64.3 | 8.6 | 12 | 63.2 | 18.5 | 21 | 63.3 | 12.4 |
| Elsewhere in New York State | 3 | 21.4 | 2.9 | 5 | 26.3 | 7.7 | 8 | 24.3 | 4.7 |
| Outside New York State | 2 | 14.3 | 1.9 | 2 | 10.5 | 3.1 | 4 | 12.1 | 2.3 |
| Unknown | 0 | .. | .. | 0 | .. | .. | 0 | .. | .. |
| Sub-total | 14 | 100.0 | 13.4 | 19 | 100.0 | 29.3 | 33 | 100.0 | 19.4 |
| Total | 105 | xxx | 100.0 | 65 | xxx | 100.0 | 170 | xxx | 100.0 |

* Includes records for 68 camps, but one was abandoned and two became permanent residences.

camps, the only real difference involved the out-of-state owners of camps not used for deer hunting. There were 21 (23.1 per cent) such owners at Lake Titus compared with six (13.0 per cent) elsewhere in the town. Since no other major differences were apparent, the two groups were combined, and the data were tested by chi-square to see if differences existed between residence categories for camps used for deer hunting and those not used for deer hunting. The chi-square value (1.23 with 2 d.f.) was non-significant at the 95 per cent level of confidence, indicating that no differences existed.

Distance From Camp The relationship between the distance to a camp from the owner's place of residence and the incidence of camp ownership in the Town of Malone was examined in two ways. First, the data were compared with respect to camps at Lake Titus and those elsewhere in the town. The second comparison was made between the camps used for deer hunting and those not so used.

Since the vicinity of Lake Titus appeared to be in high demand for recreational purposes, it was possible that persons with camps there might be travelling greater distances than others. The data for this comparison are given in Table 6. While nearly a third of the owners of camps at Lake Titus travelled over 100 miles to their camps, about half travelled 10 miles or less. For the owners of other camps in the town, about one-fourth travelled over 100 miles and under half travelled 10 miles or less. However, a chi-square test revealed no significant difference between the two groups of camp owners. Interestingly, for both groups, the majority of the owners of active camps lived within 10 miles. Also in both cases, more travelled over 100 miles than travelled from 11 to 100 miles. This is understandable since the Village of Malone,

Table 6. Comparison of Camps at Lake Titus and Other Camps in Town of Malone With Respect to Distance From Owner's Place of Residence*

| Distance from place of residence (miles) | Lake Titus | | Elsewhere | | Total | |
|---|---|---|---|---|---|---|
| | Number | Per cent | Number | Per cent | Number | Per cent |
| 0– 10 | 53 | 51 | 31 | 46 | 84 | 48 |
| 11– 25 | 8 | 8 | 4 | 6 | 12 | 7 |
| 26– 50 | 2 | 2 | 4 | 6 | 6 | 4 |
| 51–100 | 6 | 5 | 3 | 4 | 9 | 5 |
| 101–200 | 6 | 5 | 6 | 9 | 12 | 7 |
| 201–500 | 17 | 16 | 10 | 15 | 27 | 16 |
| Over 500 | 9 | 9 | 1 | 1 | 10 | 6 |
| Unknown or camp inactive | 4 | 4 | 9 | 1 | 13 | 7 |
| Total | 105 | 100 | 68 | 100 | 173 | 100 |
| Average (miles) | 180.3 | | 98.5 | | 150.1 | |

* Chi-square test: $\chi^2 = 11.49$ with 7 d.f.; non-significant at 95 per cent level of confidence.

Table 7. Comparison of Deer-hunting and Non-deer-hunting Camps in Town of Malone With Respect to Distance From Owner's Place of Residence*

| Distance from place of residence (miles) | Deer-hunting | | Non-deer-hunting | | Total | |
|---|---|---|---|---|---|---|
| | Number | Per cent | Number | Per cent | Number | Per cent |
| 0– 10 | 21 | 64 | 63 | 45 | 84 | 48 |
| 11– 25 | 2 | 6 | 10 | 7 | 12 | 7 |
| 26– 50 | 4 | 12 | 2 | 1 | 6 | 3 |
| 51–100 | 0 | 0 | 9 | 6 | 9 | 5 |
| 101–200 | 0 | 0 | 12 | 9 | 12 | 7 |
| 201–500 | 4 | 12 | 23 | 17 | 27 | 16 |
| Over 500 | 2 | 6 | 8 | 6 | 10 | 6 |
| Unknown or camp inactive | 0 | 0 | 13 | 9 | 13 | 8 |
| Total | 33 | 100 | 140 | 100 | 173 | 100 |

* Chi-square test: $\chi^2=18.79$ with 7 d.f.; significant at 95 per cent level of confidence.

which is the only large community in northern Franklin County, is less than 10 miles from most camps in the town.

The data for distance travelled to camps used for deer hunting and to camps not so used are given in Table 7. A chi-square test indicated that significant differences existed. The principal difference was in the 0-10 miles category which included 64 per cent of the camps not used for deer hunting but only 45 per cent of the others. However, in all categories over 50 miles, the percentage of camps not used for deer hunting was equal to or greater than that for deer hunting camps. Of the owners of deer hunting camps, only six (18 per cent), representing 4 per cent of all the camp owners, travelled more than 100 miles to their camps. At the same time, about a third of the other camp owners travelled that far.

## Deer Take Associated With Camps

A major function of the two special game protectors employed under the project was to obtain as complete a record as possible of all deer taken in the Town of Malone, both legally and illegally, throughout the year. Each was recorded as to whether or not it was taken by a hunter staying at one of the camps in the town. The data are summarized in Table 8. During the 5-year period, a total of 60 deer were recorded. Of these, 19 (31.7 per cent) were taken by camp-related hunting (12 legally and seven illegally). Of the 41 deer taken by other hunters, 32 were taken legally and nine illegally.

In both the legal and illegal categories, the incidence of camp-related kills dropped from over 50 per cent in 1968 to zero in 1972. Since the illegal kill by camp hunters was nearly half of the total for the town as a whole, this drop was significant even though the number of illegal kills elsewhere also declined. Either hunters became less inclined to take

Table 8. Total Documented Kill of Deer in Town of Malone, Legal and Illegal, From 1968 to 1972 According to Whether Hunting Was Camp-related

| Year | Legal | | | Illegal | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Non-camp-related | Camp-related | | Non-camp-related | Camp-related | | | Camp-related | |
| | | Number | Per cent | | Number | Per cent | Number | Number | Per cent |
| 1968* | 4 | 4 | 50 | 3 | 6 | 67 | 17 | 10 | 59 |
| 1969 | 6 | 4 | 40 | 1 | 1 | 50 | 12 | 5 | 42 |
| 1970 | 2 | 3 | 60 | 3 | 0 | 0 | 8 | 3 | 38 |
| 1971 | 15 | 1 | 6 | 1 | 0 | 0 | 17 | 1 | 6 |
| 1972 | 5 | 0 | 0 | 1 | 0 | 0 | 6 | 0 | 0 |
| Total | 32 | 12 | 27 | 9 | 7 | 44 | 60 | 19 | 32 |

* In 1968 patrol by special game protectors did not begin until October 1.

deer illegally after the patrols were established or they became more elusive. The drop in the legal kill by camp-related hunting occurred primarily because the number of such hunters decreased. Although the deer population had risen slightly by 1972, hunting conditions were poor and hunters were still reluctant to go afield as a result of the low success in 1970 and 1971. In particular, they were less likely to make the preparations and travel long distances to hunt from camps. The fact that the number of deer taken legally by non-camp hunters did not decline indicates that in 1971 and 1972 most hunting was done by Malone residents hunting from permanent homes. At the same time, even this effort was less than in previous years.

### Deer Hunting Success in Relation to Residence of Camp Owner

Success can be a powerful motivating factor in determining where deer hunters go to hunt. Therefore, the camps where deer were taken were tabulated according to the place of residence of the owner (Table 9). A chi-square test indicated a significant difference. Hunting success

Table 9. Degree of Success For Deer-hunting Camps in Town of Malone According to Owner's Place of Residence*

| Place of residence | Number of camps | Camps from which hunters took deer | |
|---|---|---|---|
| | | Number | Per cent |
| Town of Malone | 21 | 10 | 48 |
| Elsewhere in New York State | 8 | 2 | 25 |
| Outside New York State | 4 | 0 | 0 |
| Total | 33 | 12 | 37 |

* Chi-square test: $\chi^2 = 10.25$ with 4 d.f.; significant at 95 per cent level of confidence but non-significant at 99 per cent level.

was markedly greater at camps whose owners were residents of the Town of Malone than at other camps. Success was poorer at camps whose owners resided elsewhere in New York State, and it was nil at camps of out-of-state owners. Thus, if hunting successs is a major determinant of where hunters go to hunt, as indicated by other data on deer hunting in New York, many non-residents of the town were being discouraged from hunting deer in the Town of Malone.

## CONCLUSIONS

This study indicates that, for camps in the Town of Malone, deer hunting is less important than other recreational uses. Fishing, alone or in combination with activities other than hunting, is the major attraction for camp owners. This pattern was most pronounced at Lake Titus, but deer hunting camps were in the minority throughout the town. Although

27 per cent of all deer taken during the study period were the result of camp-related hunting, such hunting decreased markedly during those years.

Nearly two-thirds of the camps used for deer hunting were owned by residents of the town. Also, the vast majority of all deer taken each year, whether or not by camp-related hunting, were taken by residents of the Town of Malone or adjoining town (Jackson, 1969-73). Presumably, most of those from adjacent towns hunted on a day-use basis from their own homes.

It would seem that success in deer hunting plays a key role in determining who hunts in the Town of Malone. Residents of the town have been relatively successful even though the deer population is low compared with that in other areas of the State. Non-residents, except a few from adjoining towns, have been discouraged either by reports of low deer numbers or by the experience of being unsuccessful.

A marked change in attitude among local deer hunters apparently took place during the study. In the first year (1968), 53 per cent (9 of 17) of the deer taken were taken illegally, while this proportion was only 16 per cent (7 of 43) for the four subsequent years. During the last three years, the documented illegal kill associated with camp-related hunting was zero. Either hunters curtailed their illegal hunting or they became more elusive.

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# THE BENTHIC ENVIRONMENT OF THE HUDSON RIVER IN THE VICINITY OF OSSINING, NEW YORK, DURING 1972 AND 1973[1]

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## ABSTRACT

The benthic community of the Hudson River near Ossining, New York, was sampled at monthly intervals between May 1972 and April 1973 when the river was free of ice. Petersen grab samples (0.1 square meter) were taken at six stations and washed through 250$\mu$ screens. The organisms collected were removed from the residual debris, identified and enumerated. Sediments were analyzed to determine their particle-size composition and oxidation-reduction potential. Significant differences were found between stations in the density of specimens for four of the species tested, but no explanation of these variations could be given on the basis of data collected. The fauna at Ossining contains many species classically associated with upper-estuarine conditions along the Atlantic coast of the United States and has been reasonably constant in species composition over a period of 38 years.

The benthic community of the Hudson River near Ossining, New York, was sampled between May 1972 and April 1973. Previous reports of the benthos in this area (Townes, 1937; Bowman, 1955; Hirschfield et al., 1966) have been primarily qualitative and provide only general indications of the relative abundance of the taxa reported. In the course of this study, six stations (Figure 1.) were sampled once a month during periods when the river was free of ice, and the data were analyzed to provide information on community structure, relative abundance, seasonal variations and station differences. This information qualitatively complements that of previous studies and provides a more complete data base for understanding the estuary and for evaluating future changes.

## METHODS

The samples from each station were taken during the second week of each sampling month with a 0.1-square-meter Petersen grab. They were washed through 250$\mu$ screens and preserved in 4 per cent formaldehyde with Rose Bengal stain. Specimens were picked from the residual debris using jewelers forceps under a dissecting microscope, identified and enumerated.

[1]The authors wish to acknowledge Consolidated Edison Company of New York, Inc. which supported this study.

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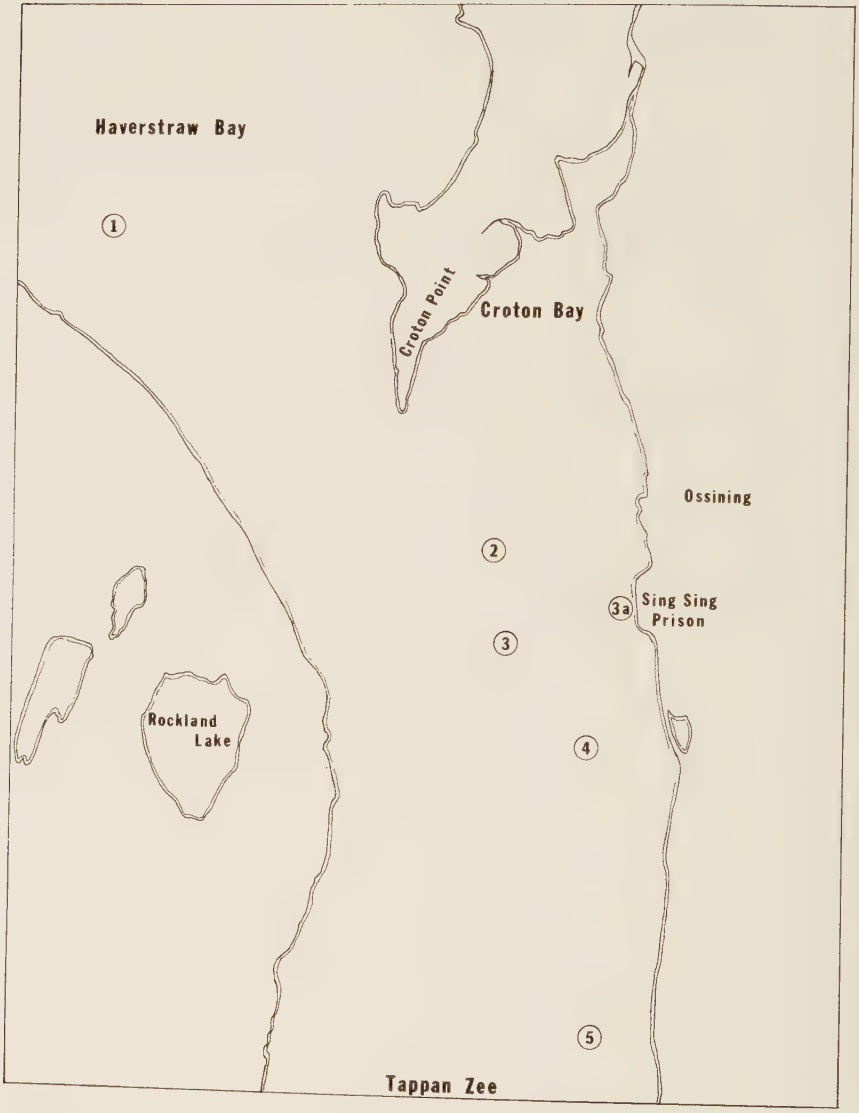


Figure 1. Map of Hudson River in vicinity of Ossining showing location of stations where benthic samples were taken.

Sediment samples were taken at each station with a Phleger corer. They were analyzed to determine the particle-size distribution using a U.S. standard sieve series (Wentworth, 1922). Oxidation-reduction potential of the samples was measured in millivolts with a platinum-calomel combination electrode.

## RESULTS

The collections included representatives of 30 taxa in seven phyla (Table 1). There were no significant differences between stations in numbers of species present, although total numbers of species collected generally increased throughout the sampling period. Total numbers of specimens were fairly constant through July and then displayed enormous increases during September and October. This was followed by a decline during November and a slight increase in December. These variations were primarily attributable to fluctuations in the numbers of harpacticoid copepods, *Amnicola* sp., *Congeria leucophaeta* and *Balanus improvisus* during late summer and early fall. Total numbers were greatly reduced in March following high mortalities of *Amnicola* and *Congeria* while the river was iced over, but they again increased in April with a second "bloom" of harpacticoid copepods.

Data for 16 species (Table 1) were tested by the Friedman two-way analysis of variance to determine differences in numbers between stations. Twelve species showed no significant variation. However, *Gammarus tigrinum* and chironomid larvae were found to be significantly ($P=.05$) more numerous at Stations 3A and 5 than elsewhere. Also, *Hypaniola grayi* was significantly more numerous at Station 3A than at Stations 1 and 5, while nematodes were more numerous at Station 2 than at Station 1.

The results of the sediment analyses are given in Table 2, the data for oxidation-reduction potentials are given in Table 3.

## DISCUSSION

At the time of this study (1972-1973), the benthic assemblage at Ossining was characteristic of classical upper-estuarine conditions and contained several species which have been reported in similar habitats along the eastern coast of the United States (Table 4). Several species observed at Ossining but not taken in quantitative sampling (*Callinectes sapidus, Cordylophora lacustris, Monoculodes* sp., *Livoneca ovalis* and *Cassidina lunifrons*) are also considered to be characteristic of these habitats. Comparison of the collections in 1972 with previous reports (Townes, 1937; Bowman, 1955; Hirschfield et al., 1966) suggests that faunal composition had not changed appreciably during a period of 38 years. There seem to have been periodic shifts in dominance during this time, but they are poorly defined due to the basically qualitative nature of the early studies. Such variations are not, however, unexpected in the estuarine environment. The relatively high numbers of *Cyathura polita* collected during this study indicate low levels of pollution at the locations sampled since this organism is reported to be intolerant to high levels of such substances (Dean and Haskin, 1964).

Table 1. Monthly, and Annual Mean, Densities of Organisms Per Square Meter of Benthic Substrate For the Hudson River Near Ossining, New York, From May 1972 to April 1973

| Taxon | 1972 | | | | | | | | 1973* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Mar. | Apr. | Mean |
| Harpacticoida§ | 0 | 0 | 358 | 662 | 890 | 15,850 | 1,370 | 2,492 | 3,068 | 11,598 | 3,629 |
| *Amnicola* sp.§ | 0 | 2 | 0 | 3 | 2,257 | 12,487 | 4,433 | 9,160 | 465 | 15 | 2,882 |
| *Congeria leucophaeta*§ | 0 | 0 | 47 | 85 | 9,018 | 9,408 | 5,662 | 3,470 | 2 | 0 | 2,769 |
| *Cyathura polita*§ | 200 | 180 | 207 | 108 | 475 | 560 | 400 | 552 | 283 | 353 | 332 |
| Chironomid larvae§ | 54 | 96 | 73 | 52 | 55 | 330 | 398 | 552 | 523 | 593 | 273 |
| *Peloscolex* sp.§ | 186 | 68 | 8 | 8 | 13 | 853 | 172 | 645 | 280 | 282 | 252 |
| *Scolecolepides viridis*§ | 256 | 174 | 100 | 70 | 97 | 235 | 122 | 113 | 408 | 883 | 246 |
| Nematoda§ | 0 | 2 | 88 | 145 | 42 | 175 | 253 | 998 | 83 | 83 | 187 |
| *Balanus improvisus*§ | 0 | 0 | 0 | 70 | 613 | 293 | 330 | 45 | 0 | 0 | 135 |
| *Leptocheirus plumulosus*§ | 0 | 0 | 0 | 0 | 562 | 72 | 17 | 47 | 70 | 87 | 86 |
| *Gammarus tigrinus*§ | 24 | 80 | 45 | 7 | 177 | 28 | 17 | 128 | 90 | 72 | 67 |
| *Boccardia hamata*§ | 0 | 12 | 0 | 0 | 102 | 2 | 298 | 215 | 3 | 0 | 63 |
| *Limnodrilus* sp.§ | 0 | 22 | 5 | 2 | 165 | 102 | 302 | 3 | 22 | 0 | 62 |
| *Hypaniola grayi*§ | 6 | 14 | 12 | 2 | 77 | 57 | 45 | 93 | 67 | 58 | 43 |
| *Corophium* sp.§ | 12 | 22 | 23 | 10 | 275 | 0 | 7 | 15 | 2 | 0 | 37 |
| Planaridae | 0 | 0 | 0 | 0 | 13 | 122 | 135 | 20 | 0 | 0 | 29 |
| *Rhithropanopeus harrisi*§ | 10 | 12 | 17 | 13 | 153 | 10 | 15 | 15 | 3 | 0 | 25 |
| *Sabella* sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120 | 32 | 0 | 15 |
| *Edotea* sp. | 0 | 0 | 0 | 0 | 0 | 52 | 13 | 50 | 8 | 13 | 14 |
| Palaeonemertina | 10 | 2 | 5 | 0 | 0 | 35 | 23 | 17 | 15 | 5 | 11 |
| Ostracoda | 0 | 0 | 23 | 17 | 2 | 23 | 3 | 8 | 8 | 0 | 8 |
| Cyclopoila | 0 | 0 | 5 | 0 | 0 | 13 | 17 | 33 | 10 | 5 | 8 |
| *Dugesia* sp. | 0 | 0 | 0 | 0 | 15 | 58 | 0 | 0 | 0 | 0 | 7 |
| Hydracarina | 0 | 0 | 0 | 0 | 0 | 5 | 3 | 40 | 8 | 3 | 6 |
| *Chaoborus* sp. | 6 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 2 |
| *Chiridotea almyra* | 0 | 0 | 0 | 3 | 12 | 0 | 0 | 0 | 0 | 0 | 2 |
| *Nereis succinea* | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 2 |
| Cumacea | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 1 |
| Acanthocephala | 0 | 0 | 0 | 7 | 2 | 0 | 0 | 0 | 0 | 2 | 1 |
| Maldanidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 7 | 1 |
| Number of species | 10 | 14 | 15 | 17 | 24 | 23 | 22 | 23 | 24 | 17 | 19 |
| Number of specimens | 764 | 690 | 1,016 | 1,262 | 15,037 | 40,775 | 14,035 | 18,831 | 5,463 | 14,064 | 11,195 |

* No samples taken during January and February when river was iced over.

TABLE 2. PARTICLE-SIZE DISTRIBUTION IN SEDIMENT SAMPLES FROM THE STATIONS NEAR OSSINING DURING PERIOD MAY 1972 TO APRIL 1973

| Category* | Screen size (millimeters) | Percentage of total weight at each station | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 3A | 4 | 5 |
| Pebble | 8 | 0.2 | 1.0 | 0.3 | 30.2 | 3.4 | 1.1 |
| Pebble | 4 | 0.1 | 0.0 | 0.1 | 14.8 | 0.0 | 0.1 |
| Granule | 2 | 0.3 | 0.1 | 0.1 | 6.4 | 0.0 | 0.2 |
| Very coarse sand | 1 | 0.4 | 0.1 | 0.1 | 2.8 | 0.4 | 0.3 |
| Coarse sand | 0.500 | 0.8 | 0.3 | 0.2 | 1.3 | 0.5 | 0.5 |
| Medium sand | 0.250 | 5.6 | 2.8 | 2.7 | 4.3 | 9.1 | 4.0 |
| Fine sand | 0.125 | 21.7 | 1.8 | 3.2 | 3.0 | 19.0 | 3.3 |
| Very fine sand | 0.062 | 11.4 | 7.3 | 6.3 | 2.3 | 10.7 | 7.0 |
| Silt and clay | 0.062 | 59.5 | 86.6 | 86.9 | 34.9 | 56.9 | 83.4 |

* After Wentworth (1922).

TABLE 3. OXIDATION-REDUCTION POTENTIAL OF SEDIMENTS AT THE SAMPLING STATIONS NEAR OSSINING FROM AUGUST TO DECEMBER IN 1972

| Month | Redox potential (millivolts) at each station | | | | | | Mean |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 3A | 4 | 5 | |
| August | −380 | −294 | −320 | −256 | −330 | −344 | −321 |
| September | −542 | −335 | −284 | −304 | −369 | −400 | −372 |
| October | −290 | −280 | −242 | −200 | −178 | −190 | −230 |
| November | −172 | − 98 | −185 | * | −149 | −111 | −143 |
| December | − 65 | −100 | − 50 | −195 | −200 | −130 | −123 |

* No core taken.

The generally low numbers, both of species and of specimens, observed during the early months of the present study seem to be attributable to the high levels of freshwater run-off experienced in the area before and during this period and their effect upon the primarily halophilic fauna. This conclusion is supported by the general increases noted in both species and specimens following the run-off period and by the considerably higher numbers of both observed during March and April in 1973 when the run-off was much lower.

The presence of high numbers of empty shells of *Congeria leucophaeta* and *Amnicola* sp. in the early spring collections in 1972 suggested that both of these populations had experienced considerable mortalities in the recent past. This was borne out by vast increases in the numbers of both species during the fall and early winter followed by the virtual absence of living specimens of either when sampling was resumed in the early spring of 1973. These data indicate that extreme fluctuations in numbers of these forms are a normal occurrence in this portion of the estuary.

Sediments are reasonably consistent throughout the area. The silt-clay fraction dominated the area sampled with only Station 3A differing

Table 4. Comparison of Faunal Assemblages in the Hudson River Near Ossining, New York, With Previously Reported Associations in the Area and At Other Locations on the Atlantic Coast of the United States

| Species | Hudson River Ossining, N.Y. (present study) | Hudson River Indian Point, N.Y. (Williams, et al., 1973) | Hudson River north of Haverstraw, N.Y. (Towues, 1937) | Hudson River Haverstraw, N.Y. (Hirschfield et al., 1966) | Hudson River Haverstraw, N.Y. (Bowman, 1955) | Raritan River New Brunswick, N.J. (Dean and Haskin, 1964) | Pocasset River Cape Cod, Mass. (Jones and Burbank, 1959) | Edisto River Wiltown Bluff, S.C. (Bowman, 1955) | Ogeechee River Kings Ferry, Ga. (Bowman, 1955) |
|---|---|---|---|---|---|---|---|---|---|
| *Gammarus tigrinus (fasciatus)* | x | x | x | x | x | | x | | |
| *Leptocheirus plumulosus* | x | x | x | x | x | | x | | |
| *Corophium lacustre* | x | x | x | x | | x | x | x | x |
| *Cyathura polita* | x | x | x | x | | | x | x | x |
| *Edotea* sp. | x | x | x | x | | | x | | |
| *Chiridotea almyra* (sp.) | x | x | x | | x | | x | x | x |
| *Hypaniola grayi* | x | x | | | | | x | | |
| *Scolecolepides viridis* | x | x | | | | | x | x | x |
| *Rhithropanopeus harrisi* | x | x | x | x | | x | | | |
| *Balanus improvisus* (sp.) | x | x | | x | | x | | | |
| *Limnodrilus* sp. | x | x | x | x | | x | | | |
| *Chaoborus* sp. | x | x | x | x | | | | | |
| *Cordylophora lacustris* | x | x | | x | | x | | | |
| *Monoculodes* sp. | x | x | x | | | | | | |

appreciably. This variation was directly attributable to large numbers of empty *Congeria leucophaeta* shells deposited at this shallow-water site which greatly increased the percentage of pebble-sized materials. Stations 1 and 4 exhibited a slightly higher sand fraction with the greatest differentiation occurring in the fine and very fine sand fractions. This physical factor did not seem to appreciably affect either species distribution or numbers during the sampling period.

Oxidation-reduction potential values were negative throughout the sampling period and showed no significant variation between stations when tested by the Friedman two-way analysis of variance. While indicating generalized reducing conditions within the sampling area, observed variations in redox potential offered no apparent explanations for the significant variations in numbers of *Gammarus,* chironomids, nematodes or *Hypaniola* which occurred at various stations.

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# SKULL MEASUREMENTS AS CRITERIA FOR AGING FISHERS

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ABSTRACT

Skulls were obtained from 42 fishers from the Adirondack region of New York. They were studied to determine which dimensions, if any, might be useful indices in aging fishers. The skulls were divided into four groups: adult male, subadult male, adult female and subadult female. Nine measurements were made on each skull. While no one measurement was shown to be an absolute indicator of age, zygomatic breadth, the greatest length of the skull and the width of the postorbital constriction all varied significantly with age in both sexes.

Skull development is a widely used indicator of age in mammals. Closure of cranial sutures is sequential and related to age (Grau et al., 1970). In animals that develop a saggital crest, the degree of development of the crest is used as an index of age. Since quantification of suture closure and crest development may require subjective judgment, an objective aging criterion based on easily obtainable information is desirable. This study was conducted to determine if various skull dimensions might be used as reliable indices in separating fishers (*Martes pennanti pennanti*) into adult and subadult age groups.

Zygomatic breadth varies primarily with age (Alexander, 1960), and this variation has been shown to be statistically significant in various species, including fishers from Maine (Wright and Coulter, 1967) and the western pine marten (*Martes caurina caurina*) (Marshall, 1951). Clark (1941) showed zygomatic breadth to be the least variable skull dimension within age groups of species of *Peromyscus* and total skull length to be nearly as constant. Postorbital constriction in fishers from Maine (Wright and Coulter, 1967) and in the pine marten (Marshall, 1951) was significantly smaller in adults than in subadults.

Gould and Kruger (1948) measured postcranial width and interorbital width to age muskrats (*Ondatra zibethicus*). Churcher (1960) found mandibular length to be age-related in red foxes (*Vulpes fulva*) and also found that the width of the postorbital process did not vary with age. Other cranial dimensions often used to determine age in mammals include basilar length, condylobasal length and cranial width.

## MATERIALS AND METHODS

Skulls from 42 fishers were available. These fishers were trapped in Hamilton and Franklin Counties in New York during the winters of 1971-72 and 1972-73. Ten skulls which had not been previously cleaned were cleaned by boiling in a water solution of ammonia and sodium sulfate (Mosby and Cowan, 1971). While drying after being cooked, skulls

shrink. Shrinkage is uniform, and the most rapid and significant shrinkage takes place in the first five days after cleaning (Alexander, 1960). The skulls, therefore, were allowed to air-dry for 2 weeks to allow sufficient time for shrinkage.

The fishers in this study had been necropsied by wildlife science students in the spring semesters in 1972 and 1973. Data sheets on the animals were completed by the students. Age and sex criteria were available for the animals taken in 1972-73. Sex had been determined by observation of the reproductive organs. Age in the males had been determined by differential baculum development. Those females without a saggital crest had been considered subadults; those with a crest had been considered adults. Age had not been determined for the 16 animals taken in 1971-72, and sex was indicated for only eight.

Sexual dimorphism with respect to skull size is greater in the fisher than in any other American mustelid (Wright and Coulter, 1967). Because of this dimorphism, sexes were kept separate for this study. Thus, the skulls were divided into four groups: adult male, subadult male, adult female and subadult female. Those animals for which sex or age information had not been recorded were placed in appropriate groups using the following methods. Sex was easily determined by the presence or absence of a baculum, which in most cases was kept with the skull when present, or by gross differences in size. In males, bacula were used to determine age group as described by Taber (1971). The skull of one male which was unaccompanied by a baculum was placed in the adult group because the saggital crest was well developed. Two unaged females were considered adult because the data sheets indicated that blastocysts had been found in them. For the remaining unaged females, the criteria of crest development and closure of the maxillary-palatine suture were used. Eadie and Hamilton (1958) considered these criteria sufficient to separate adult from subadult female fishers. Based on these criteria also, seven of the females taken in 1972-73 which had been labeled subadult were regrouped with the adults, since they did show slight development of the saggital crest and definite fusion of the maxillary-palatine suture. The resulting groupings consisted of 16 adult males, eight subadult males, 10 adult females and eight subadult females.

Nine measurements were then made on each skull. Because skulls shrink and swell in response to changes in temperature and humidity (Alexander, 1960), all the males were measured on one day and all the females were measured on one day. Measurements were taken with a vernier caliper read to the nearest 0.1 millimeter.

The following measurements were made, using the methods described by various authors as indicated: zygomatic breadth (Gould and Kruger, 1948); width of the postorbital process (Churcher, 1960); width of the postorbital constriction (Marshall, 1951); cranial width (Gould and

Kruger, 1948) and width of the mandibular condyle (Churcher, 1960). Measurements of skull length were: basilar length (Sather, 1956); condylobasal length (Gould and Kruger, 1948); greatest skull length (Wright and Rausch, 1955) and mandible length (Churcher, 1960). Measurement of the saggital crest is desirable because crest development is related to age, but it was not carried out directly since the forward edge of the crest is not distinctly defined. The saggital crest develops first at the posterior end of the skull and grows forward (Wright and Coulter, 1967), but it also extends posteriorly with increased age (Wright and Rausch, 1955). Therefore, total skull length, which was measured from the anterior incisors to the most posterior part of the crest (or cranium when the crest was not present), is a measure of crest development when compared with condylobasal length.

For each dimension, the mean was calculated for each age group. The standard deviation of each mean was calculated to indicate variability in size of the dimension within the age group. For each dimension, the difference between the means for the two age groups was tested for statistical significance, using the "Student's" *t*-test (Alder and Roessler, 1968).

## RESULTS

Tables 1 and 2 present the values calculated from the data collected from females and males, respectively. The lowest level of significance considered for the difference between means was 10 per cent.

For female skulls, the difference between the means of the two age groups was significant for three dimensions. Difference in zygomatic breadth was the only dimension with a significance level of 5 per cent. Greatest skull length and width of the postorbital constriction showed differences significant to a 10 per cent level. Those measurements with the lowest level of significance, and thus those which were least correlated with age, were cranial width and width of the mandibular condyle. The least variable dimension within an age group was width of the postorbital process.

For male skulls, seven dimensions showed statistically significant differences that were correlated with age. Of these, three were the same as those which proved significant for females, but the levels of significance were much higher in all cases (0.001 for zygomatic breadth and for greatest length of the skull, and 0.02 for width of the postorbital constriction). The age difference in cranial width was significant to a 2 per cent level. Significant to a 10 per cent level were differences in condylobasal length, width of the mandibular condyle and basilar length. In males as well as females, width of the postorbital process was the least variable with age of all the dimensions considered. In neither case did the difference in means of mandible length prove significant.

Among male skulls, dimensions were consistently less variable in sub-

TABLE 1. COMPARISON OF SKULL MEASUREMENTS (IN MILLIMETERS) WITH RESPECT TO AGE GROUP FOR 18 FEMALE FISHERS FROM THE ADIRONDACKS

| Dimension | Mean | | Standard deviation | | Value of $t$ | Level of significance |
|---|---|---|---|---|---|---|
| | Adult | Sub-adult | Adult | Sub-adult | | |
| Zygomatic breadth | 56.92 | 53.07 | 1.39 | 2.19 | 4.21 | 0.05 |
| Width of postorbital process | 25.06 | 24.20 | 0.45 | 0.56 | 0.53 | .. |
| Width of postorbital constriction | 19.39 | 20.19 | 1.02 | 0.68 | 1.79 | 0.10 |
| Cranial width | 41.30 | 40.91 | 0.72 | 1.89 | 0.39 | .. |
| Basilar length | 88.87 | 87.65 | 2.21 | 2.65 | 0.93 | .. |
| Condylobasal length | 96.69 | 94.94 | 2.22 | 2.38 | 1.52 | .. |
| Greatest skull length | 101.19 | 98.41 | 2.38 | 2.24 | 2.01 | 0.10 |
| Mandible length | 66.03 | 64.34 | 1.72 | 2.07 | 1.99 | .. |
| Width of mandibular condyle | 12.22 | 11.92 | 0.23 | 1.48 | 0.41 | .. |

TABLE 2. COMPARISON OF SKULL MEASUREMENTS (IN MILLIMETERS) WITH RESPECT TO AGE GROUP FOR 24 MALE FISHERS FROM THE ADIRONDACKS

| Dimension | Mean | | Standard deviation | | Value of $t$ | Level of significance |
|---|---|---|---|---|---|---|
| | Adult | Sub-adult | Adult | Sub-adult | | |
| Zygomatic breadth | 73.36 | 62.16 | 4.67 | 1.80 | 6.68 | 0.001 |
| Width of postorbital process | 28.07 | 27.99 | 6.04 | 1.23 | 0.05 | .. |
| Width of postorbital constriction | 20.07 | 22.56 | 1.38 | 0.97 | 2.81 | 0.02 |
| Cranial width | 48.71 | 45.74 | 2.12 | 0.95 | 2.78 | 0.02 |
| Basilar length | 106.98 | 104.39 | 3.41 | 0.95 | 1.84 | 0.10 |
| Condylobasal length | 115.38 | 113.04 | 2.91 | 0.98 | 1.88 | 0.10 |
| Greatest skull length | 125.40 | 116.72 | 3.84 | 1.82 | 6.01 | 0.001 |
| Mandible length | 82.09 | 79.26 | 2.96 | 0.84 | 1.69 | .. |
| Width of mandibular condyle | 16.66 | 14.88 | 2.12 | 0.68 | 1.76 | 0.10 |

adults than in adults, while the opposite was true among females. Males also generally showed greater differences between means of dimensions for the two age groups than did females.

## DISCUSSION

The accuracy and value of results obtained in this study depend on three basic factors: representative quality of the sample with respect to the total fisher population, accuracy of placement of skulls into age groups and precision of the measurements made.

There may be significant variation in absolute skull size in relation to habitat or geographic distribution (Alexander, 1960). Since the 42 skulls examined here were from a small local area, this factor is not likely to be important. The results, then, may be considered pertinent at least to the fisher population in the area sampled (i.e., the Adirondack region of New York). Because of the individual variability in skull size within

age groups (Gould and Kruger, 1948), a study of this nature should incorporate as large a sample as possible. While all age groups were represented here, a 42-animal sample is not large. Because of sample size, the results may be misleading. This sample consisted of animals trapped in two successive trapping seasons, with both year classes considered together. Size differences may occur in mammals from year to year within a habitat (Gould and Kruger, 1948). This possibility may lessen the value of the results. Considering two year classes as one sample may, however, be a means of averaging differences due to year class.

Grouping of skulls, as has been indicated, was somewhat arbitrary. The number of skulls for which aging required subjective judgment was small compared with the total in each group. In the case where seven female skulls were regrouped, the criteria used were probably more valid than those originally used to age these animals.

While the skulls cleaned just prior to this study were allowed ample shrinkage time, consideration must be given to the fact that the rest of the skulls had been cleaned at least 10 months earlier. There was possibly a significant difference in the two groups due to differential shrinkage. Several of the skulls prepared earlier had not been thoroughly cleaned, and adhering flesh made measurement difficult. This most affected measurement of width of the mandibular condyle and, to some exent, basilar length.

Because of overlap in dimension size between adults and subadults, no one dimension may be used as an absolute index of age. Wright and Coulter (1967) also found this to be true in their study of fishers from Maine. Considering a combination of dimensions which vary significantly with age, however, age may be determined with more precision. Zygomatic breadth proved to be the most useful measurement for age determination in both sexes. Even though there was a wide variation between individuals in the magnitude of the zygomatic breadth, the differences between the means for this measurement were more significant than those for any other dimension in both sexes. In fishers from Maine, Wright and Coulter (1967) found means in zygomatic breadth of 77.4 millimeters for adults and 64.8 millimeters for subadults. Comparable means in the present study were 73.36 and 62.16 millimeters, respectively. This difference between the two populations, if it were proven significant, may represent geographic size variation.

The next most useful dimension for aging these skulls was the greatest skull length. These two dimensions have also proven useful in aging fishers from Maine (Wright and Coulter, 1967) and the pine marten (Marshall, 1951). In his study of *Peromyscus,* Clark (1941) found these dimensions also to be highly invariable within age groups. This was not the case here. The much lower level of significance between means for condylobasal length compared with those for greatest skull length indi-

cates that the significant change in skull length with increased age is in saggital crest development.

Width of the postorbital constriction was significantly smaller in adults than subadults in this study, which is in agreement with the findings of Wright and Coulter (1967) in their study of fishers in Maine. Width of the postorbital process showed very little variation with age. This was also true in the study of red foxes by Churcher (1960).

Difference in cranial width, while highly significant in males (0.02 level), had very low significance in females.

In most cases, differences betwen means for adults and subadults were greater among males than among females. This was also reported by Wright and Coulter (1967).

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# POUND NET CATCHES OF WARM-WATER FISHES AT MONTAUK, NEW YORK[1]

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## ABSTRACT

A total of 620 warm-water fishes representing seven families and 14 species were captured in two commercial pound nets operated in Fort Pond Bay at Montauk, New York, during the periods from July 9 to August 30 and from October 3 to 30 in 1973. Where sufficient numbers of individuals were taken, length-frequency distributions are presented. Of the captured individuals, 339 were tagged and released, and local movements were observed through recaptures of tagged fish. The number of warm-water fishes recorded was larger than any previously reported from the eastern Long Island area, and the tagging operations were the first of their kind in northern latitudes. Also, 10 additional species taken in the vicinity at other times are briefly mentioned.

Many warm-water fish species have been reported from the marine environs of Long Island, New York (Bean, 1887; Nichols, 1909, 1950; Alperin, 1967a, 1967b; Alperin and Schaefer, 1964, 1965; Schaefer, 1965, 1972; Schaefer and Doheny, 1970; Briggs, 1970; Austin, 1973). All of these accounts described the occurrence of species new or rare to Long Island, but few reported size-frequency distributions and none reported local movements via marked fish. The present study was undertaken to report the occurrence of warm-water species in the Montauk area, their number, sizes and size frequencies, as well as their local (and possibly migratory) movements through tagging.

## METHODS AND MATERIALS

Two pound (trap) nets owned and operated by the third author were used successfully during 1971 and 1972 in tagging over 3,800 fish of commercial and scientific value. These nets were located off the southern beach of Fort Pond Bay at Montauk, New York (Figure 1). In 1973, tagging operations were carried on from July 9 through August 30 and from October 3 through 30 for a total of 22 days. During this time, many species of warm-water fish were trapped and tagged, and their

[1]Contribution No. 23 of the New York Ocean Science Laboratory. The authors wish to acknowledge the following for their aid in this study: Dr. Herbert M. Austin, Dr. Rudolph Hollman, Carl O. Mamay, Herbert Weigand and Brad Loewen.

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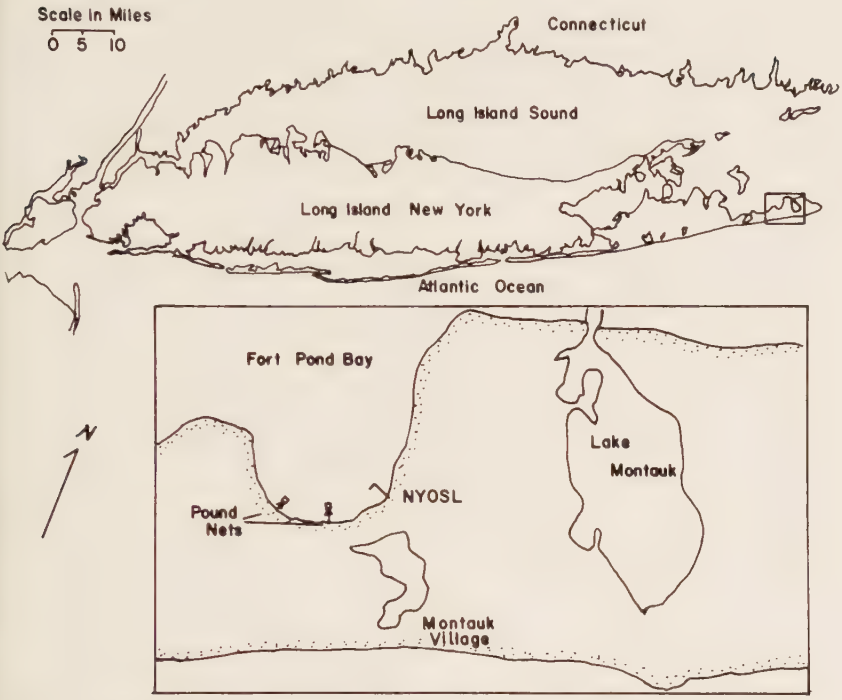


Figure 1. Map of Long Island showing location of Fort Pond Bay and enlargement showing location of the pound net used for tagging operations.

numbers and lengths (to the nearest millimeter) were recorded. Floy Mark II tagging guns and FD-68B anchor tags were used throughout. All recaptured fish were enumerated and released.

## RESULTS AND DISCUSSION

In the 1973 study, 620 warm-water fish (7 families, 14 species) were captured, of which 339 were tagged and released (Table 1). Although the work began on July 9, substantial numbers of warm-water species were not taken until August 14. Surface temperatures for the period ranged from 24.2° C. on July 9 to 14.2° C. on October 30 (Table 2).

The majority of reports of warm-water fishes in Long Island waters have been from the western south shore bays and near-shore ocean waters. Far fewer reports exist for the Montauk-Orient area of eastern Long Isand. Reasons for this may be two-fold. First, the areas differ environmentally. The eastern localities are more influenced by offshore waters of Atlantic Ocean, Block Island Sound and eastern Long Island Sound origins, and less by inshore conditions and land runoff, than are the western localities. In addition, water temperatures to the west often exceed those of the eastern areas during the summer. Second, few in-

Table 1. Warm-water Fishes Caught and Tagged in Fort Pond Bay During Period July 9 to October 30 in 1973

| Family and species | Number caught | Number tagged | Number of recaptures |
|---|---|---|---|
| Priacanthidae | | | |
| *Priacanthus cruentatus* | 1 | 0 | .. |
| Carangidae | | | |
| *Caranx crysos* | 140 | 105 | 36 |
| *Caranx hippos* | 21 | 21 | 0 |
| *Caranx latus* | 1 | 0 | .. |
| *Decapterus punctatus* | 1 | 0 | .. |
| *Selar crumenophthalmus* | 422 | 186 | 11 |
| *Seriola zonata* | 9 | 9 | 1 |
| Sciaenidae | | | |
| *Bairdiella chrysura* | 9 | 8 | 1 |
| *Leiostomus xanthurus* | 4 | 3 | 0 |
| Trichiuridae | | | |
| *Thrichiurus lepturus* | 1 | 0 | .. |
| Scombridae | | | |
| *Scomberomorus maculatus* | 2 | 0 | .. |
| Balistidae | | | |
| *Aluterus schoepfi* | 6 | 6 | 0 |
| *Monacanthus hispidus* | 1 | 0 | .. |
| Diodontidae | | | |
| *Chilomycterus schoepfi* | 2 | 1 | 0 |
| Total | 620 | 339 | 49 |

Table 2. Surface Water Temperatures in Fort Pond Bay on Tagging Dates in 1973

| Date | Temperature (° C.) |
|---|---|
| July 9 | 24.2 |
| 12 | 20.3 |
| 13 | 20.3 |
| 16 | 19.4 |
| 17 | 18.9 |
| 19 | 20.8 |
| 24 | 20.6 |
| 25 | 22.2 |
| August 2 | 19.2 |
| 7 | 22.5 |
| 9 | 21.9 |
| 14 | 23.1 |
| 16 | 20.6 |
| 17 | 21.7 |
| 20 | 19.2 |
| 29 | 22.6 |
| 30 | 22.8 |
| October 3 | 18.6 |
| 8 | .. |
| 10 | 18.1 |
| 12 | 17.2 |
| 30 | 14.2 |

vestigations have been conducted in and around the Montauk area, while extensive sampling has been done in western Long Island localities, particularly the Great South Bay-Fire Island area.

The capture of adults of some species (notably *Caranx crysos*) is significant in that most reports of warm-water fish in northern latitudes are of juveniles, which are probably carried northward with the Gulf Stream. The capture of adult individuals in this area indicates a northerly migration as part of the nekton rather than the plankton. Adults of warm-water species have been reported from western Long Island waters by Alperin and Schaefer (1964, 1965) and Schaefer (1965, 1972) and from eastern Long Island by Austin (1973).

Warm-water fishes are probably present in far greater numbers in northern latitudes than most reports have indicated, and the large quantity reported here was probably a result of the frequency of sampling. Similarly, Alperin and Schaefer (1964) reported the capture of many warm-water fishes from Great South Bay after an ambitious sampling program.

The number of specimens of warm-water species collected during the present study is among the largest reported from the Long Island area and is the largest reported thus far from eastern Long Island waters. Although concise records of warm-water fish catches were not kept prior to this sampling period, it is felt that this catch was the largest in the four years (1970-1973) that these pound nets had been operated by the third author. In addition to the 14 species taken in 1973, 10 other species were taken in the vicinity at other times. The species are discussed individually.

## Species Taken in 1973

Each species captured in the pound nets during 1973 is discussed under the family to which it belongs, the families being arranged in the order of their frequency in the catch.

### Carangidae

*Caranx crysos* (blue runner)

Catch statistics for the blue runner are presented in Table 3. The 105 tagged fish averaged 161 millimeters (109-385) in standard length and 173 millimeters (118-415) in fork length. The mean factor for converting standard length to fork length was 1.075 and for fork length to standard length it was 0.930. The size-frequency distribution is presented in Figure 2. The majority of blue runners were captured on August 14-17 (water temperature 20.6-23.1° C.). This 4-day period also produced the most recaptures of tagged fish (26), as well as the greatest

Table 3. Catch and Tagging Statistics For the Blue Runner (*Caranx crysos*) and Bigeye Scad (*Selar crumenophthalmus*) in Fort Pond Bay in 1973

| Date | Blue runner | | | Bigeye scad | | |
|---|---|---|---|---|---|---|
| | Number caught | Number tagged | Number of recaptures | Number caught | Number tagged | Number of recaptures |
| July 24 | 0 | 0 | .. | 1 | 0 | .. |
| August 7 | 1 | 1 | 0 | 0 | .. | .. |
| 9 | 2 | 2 | 5 | 0 | .. | .. |
| 14 | 26* | 25 | 18 | 4 | 4 | 1 |
| 16 | 44§ | 43 | 4 | 13 | 13 | 4 |
| 17 | 42† | 12 | 3 | 13 | 13 | 0 |
| 20 | 4 | 4 | 0 | 54 | 54 | 0 |
| 29 | 6 | 5 | 2 | 87 | 81 | 6 |
| 30 | 3‡ | 1 | 0 | 253 | 21 | 0 |
| October 3 | 0 | .. | .. | 1 | 0 | .. |
| 10 | 1 | 1 | 0 | 0 | .. | .. |
| 12 | 5 | 5 | 0 | 0 | .. | .. |
| 30 | 6 | 6 | 0 | 0 | .. | .. |
| Total | 140 | 105 | 32° | 422 | 186 | 11 |

* One fish 265 millimeters in standard length; others $\leq$175 millimeters.
§ One fish 385 millimeters in standard length; others $\leq$176 millimeters.
† Twelve fish $\leq$168 millimeters in standard length; 30 fish $>$300 millimeters.
‡ Two fish $\leq$145 millimeters in standard length; one $>$250 millimeters.
° In addition, one fish was recaptured four times in Three Mile Harbor; thus instances of recapture totalled 36.

quantity (31) of marketable-sized adult blue runners larger than 300 millimeters in standard length.

Recaptures of tagged blue runners in the pound nets at Fort Pond Bay proved very interesting. Nineteen fish were recaptured once, five were recaptured twice and one was recaptured three times for a total of 32 recaptures. In addition, one fish tagged on August 14 travelled approximately 12 nautical miles to the west in 4 days where it was captured and released four times in a commercial pound net in Three Mile Harbor. The last recapture of this individual was on August 26, 12 days after tagging. Most recaptures in Fort Pond Bay occurred within 3 days after tagging; however, a few fish remained in the area as long as 7 to 8 days (Table 4). No other species of fish that was tagged in numbers during the two years of this program was observed to remain in the area so long immediately after tagging.

*C. crysos* has previously been reported from the Long Island area by Baird (1854), Murphy and Harper (1915), Latham (1919), Schaefer (1967) and Alperin (1967a). Nichols and Breder (1926) found this species to be a casual or rare occurrence in the vicinity of Long Island, while Alperin (1967a) noted that it was very common in 1964 and probably the most common carangid in that area.

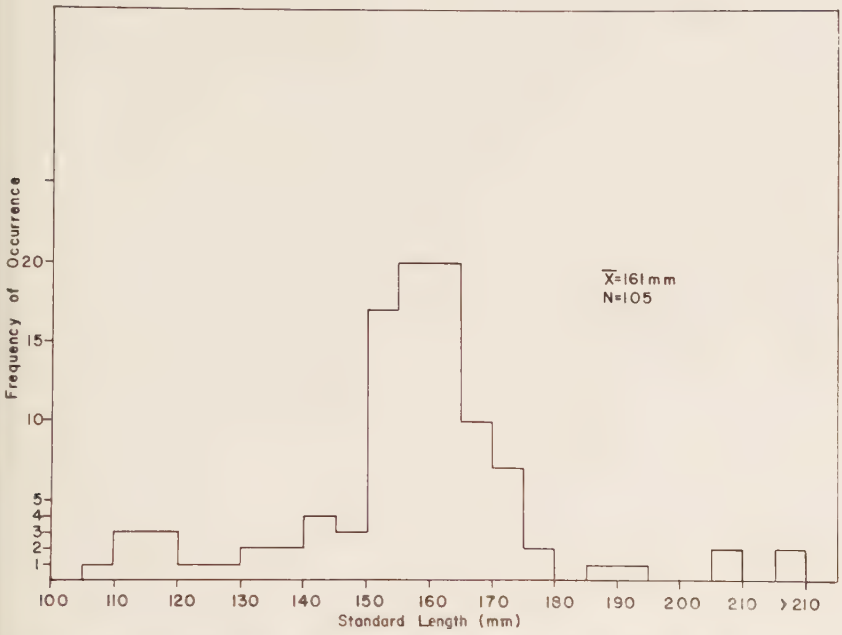


Figure 2. Length-frequency distribution of the blue runners tagged at Fort Pond Bay.

TABLE 4. RECAPTURES OF TAGGED BLUE RUNNERS (*Caranx crysos*) IN FORT POND BAY AS A FUNCTION OF TIME

| Date tagged | Number tagged | Number of recaptures according to number of days after tagging | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| August 9 | 2 | .. | .. | .. | .. | 2 | .. | 2 | 1 |
| 14 | 25 | .. | 14 | 4 | .. | .. | .. | .. | .. |
| 16 | 43 | 4 | .. | .. | .. | .. | .. | .. | .. |
| 17 | 12 | .. | .. | 3 | .. | .. | .. | .. | .. |
| 29 | 5 | 2 | .. | .. | .. | .. | .. | .. | .. |

Berry (1959) stated that larvae and young juveniles of *C. crysos* are carried northward by the Gulf Stream and that fish smaller than 100 millimeters in standard length are seldom found inshore. However, during the summer of 1971, one specimen was noted which measured 50 millimeters in standard length and 56 millimeters in fork length. The absence of records in this area of fish from inshore waters from December through June indicates that they either move offshore or migrate south during this cold period.

*Caranx hippos* (crevalle jack)

A total of 21 crevalle jacks were captured and tagged, 17 on October 10 (water temperature 18.1° C.) and four on October 12 (water temperature 17.2° C.). These fish averaged 161 millimeters (120-180) in standard length and 174 millimeters (133-195) in fork length. Mean conversion factors for standard length to fork length and for fork length to standard length were 1.081 and 0.925, respectively. No fish were recaptured.

Previous occurrences of *C. hippos* in the Long Island area were reported by Gordon (1949), Alperin and Schaefer (1964), Alperin (1967a), Schaefer (1967), Zawacki (1972) and Reisman and Nichol (1973). As with *C. crysos,* this species either moves offshore or migrates south during the colder months between December and March (Berry, 1959).

*Caranx latus* (horse-eye jack)

One specimen was captured during early August. Although size data are not available, it was within the range recorded for *C. hippos.* As this species was not reported by Alperin (1967a) to occur in Long Island waters, this may constitute the first record from this area.

*Decapterus punctatus* (round scad)

One specimen was captured on August 29 (water temperature 22.6° C.) which measured 110 millimeters in standard length and 122 millimeters in fork length. This species has been reported from the Long Island area by Gordon (1949) and Alperin (1967a).

*Selar crumenophthalmus* (bigeye scad)

Most of the bigeye scad were captured between August 20 and 30 (water temeprature 19.2°-22.8° C.), with 60 per cent of the total catch being made on August 30 (Table 3). The 186 fish that were tagged averaged 133 millimeters (95-151) in standard length and 144 millimeters (105-164) in fork length. Mean conversion factors for standard length to fork length and for fork length to standard length were 1.083 and 0.923, respectfully. The size-frequency distribution is shown in Figure 3.

Recaptures of tagged fish were far fewer than for the blue runner. One bigeye scad tagged on August 14 was recaptured on August 16, four tagged on August 16 were recaptured on August 17, and six tagged on August 29 were recaptured on August 30. All of these recaptures occurred in the nets at Fort Pond Bay. No individual fish was recaptured more than once.

Previous reports of bigeye scad from the Long Island area all occurred during the months of July through October (Alperin, 1967a; Schaefer, 1967; Perlmutter, 1971; Zawacki, 1972).

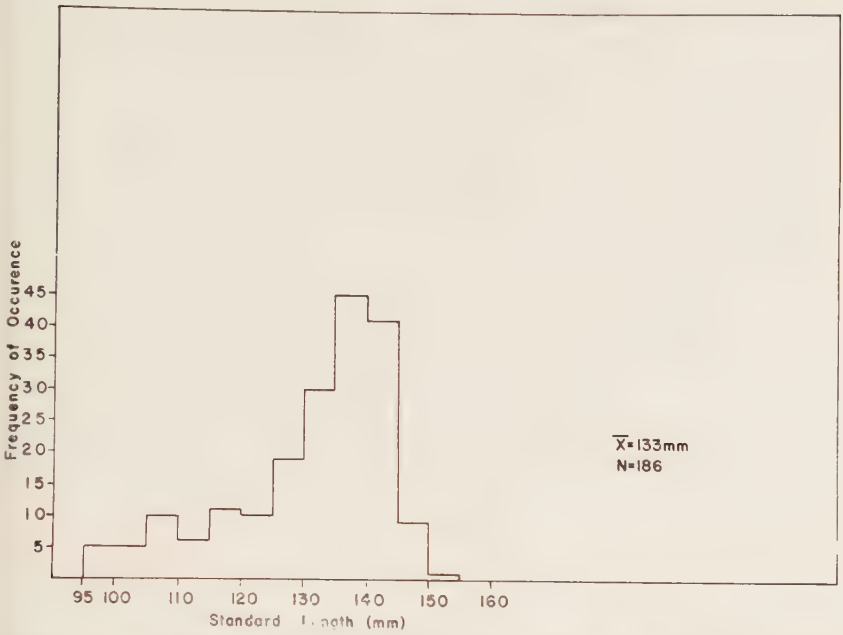


Figure 3. Length-frequency distribution of the bigeye scad tagged at Fort Pond Bay.

*Seriola zonata* (banded rudderfish)

Nine banded rudderfish were captured and tagged between August 29 (water temperature 22.6° C.) and October 30 (water temperature 14.2° C.). They averaged 204 millimeters (147-250) in standard length and 222 millimeters (164-275) in fork length. Mean conversion factors for standard length to fork length and fork length to standard length were 1.092 and 0.916, respectively.

One specimen, tagged on August 30, was captured and released by a fisherman using hook and line in Fort Pond Bay on September 17. On numerous occasions through October 10, a tagged fish was observed by the authors to be swimming and feeding with a small school (about 12) of its kind around the New York Ocean Science Laboratory pier in Fort Pond Bay.

This species has been reported from the Long Island area by Alperin (1967a) and Schaefer (1967).

Sciaenidae

*Bairdiella chrysura* (silver perch)

Nine silver perch were captured between July 25 (water temperature 22.2° C.) and October 12 (water temperature 17.2° C.). Eight fish were

tagged which averaged 165 millimeters (150-191) in standard length and 201 millimeters (180-229) in total length. Mean conversion factors for standard length to total length and total length to standard length were 1.221 and 0.819, respectively.

One specimen, tagged on August 7, was recaptured on August 17. The species has previously been reported from this area by Latham (1919), Greeley (1939), Alperin and Schaefer (1964) and Schaefer (1967).

*Leiostomus xanthurus* (spot)

Four spot were captured between October 10 (water temperature 18.1° C.) and October 12 (water temperature 17.2° C.). Three tagged fish measured 127, 134 and 150 millimeters, respectively, in standard length and 153, 159 and 178 millimeters, respectively, in fork length. None was recaptured. The species has previously been reported from this area by Baird (1854), Latham (1919), Greeley (1939), Alperin and Schaefer (1964) and Schaefer (1967).

## Balistidae

*Aluterus schoepfi* (orange filefish)

Six orange filefish were captured and tagged between July 12 (water temperature 20.3° C.) and August 29 (water temperature 22.6° C.). They averaged 368 millimeters (345-390) in standard length. None was recaptured. During the summer of 1971, one was noted which measured 281 millimeters in standard length and 331 millimeters in total length.

The species has been reported from the Long Island area by Latham (1919), Greeley (1939), Gordon (1949), Alperin and Schaefer (1964) and Schaefer (1967). The largest specimen taken was 225 millimeters long (Schaefer, 1967).

*Monacanthus hispidus* (planehead filefish)

One planehead filefish, about 100 millimeters in total length, was captured on October 10 (water temperature 18.1° C.). This species has previously been reported from the Long Island area by Greeley (1939), Gordon (1949), Alperin and Schaefer (1964, 1965) and Schaefer (1967).

## Diodontidae

*Chilomycterus schoepfi* (striped burrfish)

Two striped burrfish were captured, one on July 12 (water temperature 20.3° C.) and one on July 25 (water temperature 22.2° C.). One fish was tagged which measured 170 millimeters in standard length and 205 millimeters in total length. There were no recaptures. Schaefer (1967) reported the capture of 36 *C. schoepfi* from the Long Island area with

a length range of 80 to 260 millimeters. It was also reported from this area by Murphy and Harper (1915) and Gordon (1949).

### Scombridae

*Scomberomorus maculatus* (Spanish mackerel)

Two Spanish mackerel, over 250 millimeters in total length, were captured on August 29 (water temperature 22.6° C.). None was tagged.

### Priacanthidae

*Priacanthus cruentatus* (glasseye snapper)

One glasseye snapper was captured during the last week of September (water temperature about 18° C.) which measured 94 millimeters in standard length and 115 millimeters in fork length. It was not tagged.

### Trichiuridae

*Trichiurus lepturus* (Atlantic cutlassfish)

One Atlantic cutlassfish, measuring 745 millimeters in total length, was captured during the last week of September (water temperature about 18° C.). It was not tagged. The data given by Dawson (1967) suggest that an individual of this length is a mature fish, 2+ years of age. The species has been previously reported in the Long Island area by Bean (1903), Nichols and Breder (1926), Breder (1932) and Alperin and Schaefer (1965).

### Species Taken in 1971

During the summer-fall period of 1971, nine warm-water species (each represented by one individual) were captured in the pound nets at Fort Pond Bay. Dates of capture were not recorded for all individuals. Two of these species (*Caranx crysos* and *Aluterus schoepfi*) have been discussed. Another (*Balistes carolinensis*) is discussed under "Miscellaneous". The following were the remaining six species.

A ladyfish (*Elops saurus*), captured on October 22, measured 298 millimeters in standard length and 318 millimeters in fork length.

A garfish (*Tylosurus* sp.), captured on November 3, measured 638 millimeters in standard length and 654 millimeters in fork length.

A leatherjacket (*Oligoplites saurus*) was near the maximum of 280 millimeters recorded by Alperin (1967a).

A Florida pompano (*Trachinotus carolinus*) measured 41 millimeters in standard length and 47 millimeters in fork length.

A permit (*Trachninotus falcatus*) measured 43 millimeters in standard length and 46 millimeters in fork length.

A harvestfish (*Peprilus alepidotus*) measured 128 millimeters in standard length and 138 millimeters in fork length.

### Miscellaneous

In addition to the fish already described, four warm-water species were brought to the authors' attention during 1973 by local fishermen who were curious about what they had caught. Precise information regarding date and place of capture, water temperature, etc. were not available in all cases.

*Pristigenys alta* (short bigeye)

One short bigeye, measuring 32 millimeters in standard length and 41 millimeters in total length, was captured in Block Island Sound during mid-October (water temperature about 17° C.). This species was previously recorded in the Long Island area by Breder and Nigrelli (1934), Greeley (1939), Morrow (1957), Caldwell (1962) and Alperin and Schaefer (1965).

*Selene vomer* (lookdown)

One lookdown, measuring 34 millimeters in standard length and 38 millimeters in fork length, was captured by haul seine off the ocean beach at Montauk on July 19 (water temperature about 21° C.). Conversation with both commercial and sport fishermen revealed that many lookdowns had been seen and captured in the Montauk area and in Lake Montauk during July. This species was previously reported by Gordon (1949), Alperin (1967a) and Schaefer (1967).

*Macrorhamphosus scolopax* (longspine snipefish)

One longspine snipefish, about 100 millimeters in total length, was captured during July near Montauk Point. This species is of eastern Atlantic origin (Bigelow and Schroeder, 1953) and to the authors' knowledge has been previously reported in the western Atlantic only from the Massachusetts-Gulf of Maine region. This report, then, probably constitutes the first from the Long Island area.

*Balistes carolinensis* (triggerfish)

One triggerfish, measuring 342 millimeters in standard length and weighing 1,309 grams, was found dead on the beach in Fort Pond Bay on November 8 (water temperature 10.6° C.). The fish appeared uninjured and probably fell victim to rapidly decreasing temperatures, as do many fish of southern origins (Alperin, 1967a). The species has been reported from Long Island by Latham (1919). During the summer of 1971, a specimen was noted which measured 206 millimeters in standard length and 234 millimeters in total length.

## CONCLUSIONS

Many species of warm-water fish appear seasonally in the waters of Long Island and vicinity. Some may be present in far greater numbers than have been reported from previous studies, as indicated by the large catches of *Caranx crysos* and *Selar crumenophthalmus* recorded here. These catches were probably due in part to the frequency of sampling.

There are few reports of warm-water fishes in this area for the months preceding July. Probably the fish have not arrived in the area, being either in transit or remaining offshore in the warm Gulf Stream and avoiding movement shoreward into the cool waters that exist there in early summer.

Both adults and juveniles of some species occur in this area, which tends to indicate a migratory habit of larger fish as well as a northerly "wandering" or "straggling" of juveniles with the Gulf Stream.

Recaptures of the species studied suggest that they undergo little stress due to tagging operations. Therefore, tagging affords a means of learning more about the movements (migratory and local) of warm-water species in northern latitudes.

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# AN EVALUATION OF ARTIFICIAL REEFS IN NEW YORK'S MARINE WATERS[1]

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ABSTRACT

Two artificial reefs, Kismet reef in Great South Bay and Fire Island reef in the Atlantic Ocean, were studied to determine their success in attracting finfish. Kismet reef attracted large numbers of fish, with catches dominated by tautog. Fire Island reef also attracted many fish, although no one species dominated the catch. Both reefs were considered successful. Kismet reef was often overcrowded in the fall, and expansion to its full authorized area seems desirable. Future artificial reef building in New York waters might best be directed toward the south shore bays and similar sheltered waters, although present oceanic reefs should not be abandoned.

Since 1962, the State Department of Environmental Conservation has built or assisted in building seven reefs in Long Island waters (Zawacki, 1969). In 1969, the Department undertook a study to determine whether or not artificial reefs were successful in attracting finfish for anglers to catch. Two reefs, Kismet reef and Fire Island reef, were chosen for study.

## DESCRIPTION OF THE REEFS

Kismet reef, in Great South Bay in approximately 6 meters of water (Figure 1), is 457 meters long and 46 meters wide. It is made of two sunken barges, 20,000 concrete building blocks and 1,150 auto tire units (each unit consisting of three tires embedded in concrete). It is of low profile with little material rising more than 1 meter off the bottom except for one barge which rises about 4 meters.

Fire Island reef, in the Atlantic Ocean in approximately 21 meters of water about 4 kilometers south of Fire Island, is 1.6 kilometers long and 0.2 kilometer wide. It is composed of approximately 20,000 cubic meters of rock and building rubble, 500 auto tire units, 40 concrete tubular structures about 2.4 meters in diameter and 1.1 meters high, a sunken 20-meter-long wooden hull and 10 sunken barges (varying from 27 to 52 meters in length). This reef has a low profile, similar to the other, except where barges rise about 4 meters off the bottom.

## GEAR AND METHODS

Fish and invertebrates frequenting the reef were caught in rectangular

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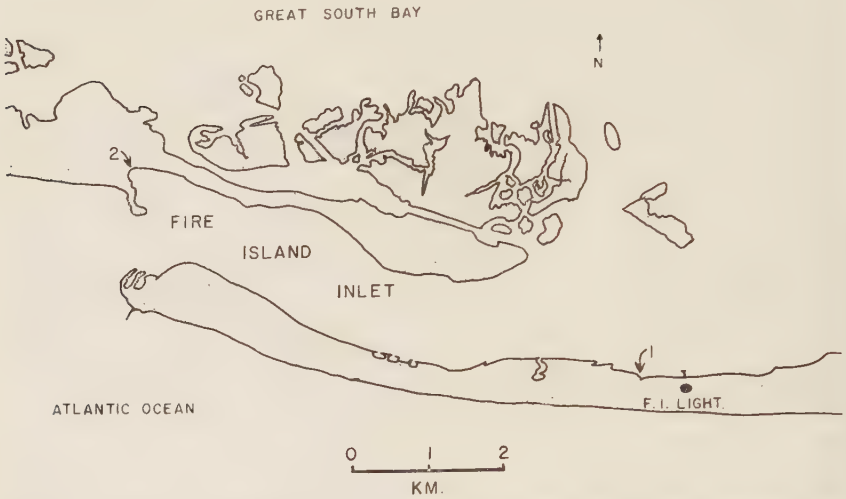


Figure 1. Map of Great South Bay in vicinity of Fire Island Inlet showing location of artificial reefs studied.

pots measuring 91.4 by 45.7 by 30.5 centimeters. Two strings of five pots were fished on each reef from May through November in 1969, 1970 and 1972 and from May through July and late September through early December in 1971. The pots were lifted and emptied 200 times at Kismet reef and 107 times at Fire Island reef.

All fish caught in the pots were identified and counted. Also, observations were made of fishes that were caught on rod and reel or seen swimming on the reefs, but not caught in the pots. Invertebrates caught in the pots were identified and counted only in 1972. In addition, observations were made on the organisms that grew on or in the gear.

## RESULTS

The catch records and related observations are presented for the fishes and the invertebrates separately.

### Fishes

Thirty-two species of fish were caught in the pots at Kismet reef (Table 1). Tautog dominated the catch (58 per cent). Cunner were next in abundance (36 per cent). Only two other species, oyster toadfish and winter flounder, comprised as much as 1 per cent of the catch.

A few of the fishes caught at Kismet reef showed seasonal variations. Most of the winter flounder were caught in May and June (37 per cent) and in November and December (40 per cent), while 71 per cent of the northern puffer were caught in May and June. Most of the north-

Table 1. Numbers of Fish Caught in Pots at the Artificial Reefs

| Species | Kismet reef | Fire Island reef |
|---|---|---|
| Tautog (*Tautoga onitis*) | 7,032 | 298 |
| Cunner (*Tautogolabrus adspersus*) | 4,374 | 1,088 |
| Black sea bass (*Centropristis striata*) | 30 | 509 |
| Ocean pout (*Macrozoarces americanus*) | 0 | 335 |
| Scup (*Stenotomus chrysops*) | 11 | 248 |
| Red hake (*Urophycis chuss*) | 6 | 144 |
| Oyster toadfish (*Opsanus tau*) | 137 | 0 |
| Winter flounder (*Pseudopleuronectes americanus*) | 133 | 2 |
| Northern puffer (*Sphoeroides maculatus*) | 98 | 1 |
| Northern pipefish (*Syngnathus fuscus*) | 50 | 1 |
| Grubby (*Myoxocephalus aenaeus*) | 46 | 0 |
| Sea raven (*Hemitripterus americanus*) | 3 | 40 |
| Longhorn sculpin (*Myoxocephalus octodecimspinosus*) | 9 | 19 |
| Rock gunnel (*Pholis gunnellus*) | 20 | 7 |
| American eel (*Anguilla rostrata*) | 27 | 0 |
| Lined seahorse (*Hippocampus erectus*) | 8 | 17 |
| Northern kingfish (*Menticirrhus saxatilis*) | 25 | 0 |
| Conger eel (*Conger oceanicus*) | 5 | 16 |
| Windowpane (*Scophthalmus aquosus*) | 10 | 8 |
| Striped searobin (*Prionotus evolans*) | 13 | 2 |
| Planehead filefish (*Monacanthus hispidus*) | 2 | 13 |
| White hake (*Urophycis tenuis*) | 1 | 10 |
| Snowy grouper (*Epinephelus niveatus*) | 1 | 7 |
| Northern searobin (*Prionotus carolinus*) | 3 | 3 |
| Smallmouth flounder (*Etropus microstomus*) | 6 | 0 |
| Seasnail (*Liparis atlanticus*) | 0 | 5 |
| Spotted hake (*Urophycis regius*) | 0 | 4 |
| Silver perch (*Bairdiella chrysura*) | 3 | 0 |
| Butterfish (*Peprilus triacanthus*) | 0 | 2 |
| Smooth dogfish (*Mustelus canis*) | 1 | 0 |
| Alewife (*Alosa pseudoharengus*) | 1 | 0 |
| Atlantic tomcod (*Microgadus tomcod*) | 1 | 0 |
| Fourspine stickleback (*Apeltes quadracus*) | 1 | 0 |
| Gag (*Mycteroperca microlepis*) | 1 | 0 |
| Spotfin butterflyfish (*Chaetodon ocellatus*) | 1 | 0 |
| Seaweed blenny (*Blennius marmoreus*) | 0 | 1 |
| Radiated shanny (*Ulvaria subbifurcata*) | 0 | 1 |
| Gray triggerfish (*Balistes capriscus*) | 1 | 0 |

ern pipefish (84 per cent), longhorn sculpin (78 per cent) and lined seahorse (63 per cent) were caught from October through December.

In addition to those fishes caught in the pots, SCUBA divers from the National Marine Fisheries Service observed striped bass (*Morone saxatilis*) at Kismet reef (Larry Ogren, personal communication). Large schools of American sand lance (*Ammodytes americanus*) were observed on occasion swimming near the surface.

Anglers aboard party boats were seen catching summer flounder (*Paralichthys dentatus*) sporadically during the summer. Although relatively few anglers were seen at Kismet reef during the summer, it was heavily fished in the fall. Usually four party boats (averaging about 15 anglers each) and about 20 private boats (averaging about two anglers each) were anchored on the reef each time we visited it from late September

through November. At times the reef was so crowded with boats anchored on it during the fall that we had difficulty retrieving and resetting our pots.

Letters that accompanied tag returns from fish caught at the reef indicated that catches of 20 to 30 tautog per angler per trip were common in the fall. One report from the National Marine Fisheries Service Marine Sport Fishing Survey (unpublished data) showed that three men fishing for 2½ hours at Kismet reef on October 23, 1971 caught "over 100" tautog weighing up to 2.3 kilograms each.

Fewer species (25) were caught in the pots at Fire Island reef (Table 1), and no one dominated the catch. Cunner was the most abundant (39 per cent), followed by black sea bass (18 per cent), ocean pout (12 per cent), tautog (11 per cent), scup ( 9 per cent), red hake (5 per cent and sea raven (1 per cent).

Four species showed seasonal variations. Nearly all the ocean pout (91 per cent) and sea raven (83 per cent) were caught in May and June. Most of the tautog (71 per cent) and all the lined seahorse were caught in October and November.

We saw Atlantic mackerel (*Scomber scombrus*), Atlantic cod (*Gadus morhua*), bluefish (*Pomatomus saltatriv*), barrelfish (*Hyperoglyphe perciformis*) and banded rudderfish (*Seriola zonata*) caught on rod and reel at Fire Island reef. The banded rudderfish were attracted to the pot buoys and each summer small schools of up to a dozen individuals were seen swimming under each buoy. Freshly ingested round herring (*Etrumeus teres*) were vomited by and found in the stomachs of bluefish caught on rod and reel at this reef.

Anglers aboard party boats caught bluefish, black sea bass and scup during the summer at Fire Island reef. However this fishing was sporadic, and we rarely saw more than one boat on the reef on any one day. In late October and November, there was more fishing at this reef. At that time we usually observed two or three party boats and four or five private boats anchored or drifting over the reef with the anglers fishing primarily for Atlantic cod.

### Invertebrates

Twenty-five species of invertebrates were caught in the pots at Kismet reef (Table 2). The common mud crab dominated the catch (64 per cent). Starfish were next in abundance (23 per cent), followed by the small hermit crab (3 per cent), oyster drill (2 per cent), moonsnail (2 per cent) and a second species of mud crab (1 per cent).

Many of the invertebrates showed seasonal variations. All the blue claw crabs, most of the lady crabs (89 per cent), greedy columbellas (79 per cent), common mud crabs (71 per cent), common spider crabs (67 per cent) and rock crabs (61 per cent) were caught in October and

Table 2. Numbers of Invertebrates Caught in Pots at the Artificial Reefs in 1972

| Species | Kismet reef | Fire Island reef |
|---|---|---|
| Starfish (*Asterias forbesii*) | 1,101 | 10,280 |
| Common mud crab (*Neopanope texana sayi*) | 3,079 | 0 |
| Rock crab (*Cancer irroratus*) | 38 | 320 |
| Jonah crab (*Cancer borealis*) | 3 | 298 |
| Winter shrimp (*Dichelopandalus leptocerus*) | 0 | 190 |
| Small hermit crab (*Pagurus longicarpus*) | 155 | 4 |
| American lobster (*Homarus americanus*) | 12 | 101 |
| Oyster drill (*Urosalpinx cinereus*) | 78 | 4 |
| Spider crab (*Libinia dubia*) | 60 | 13 |
| Moonsnail (*Polinices heros*) | 70 | 2 |
| Large hermit crab (*Pagurus pollicaris*) | 26 | 29 |
| Mud crab (*Eurypanopeus depressus*) | 54 | 0 |
| The borer (*Eupleura chordata*) | 37 | 0 |
| Lady crab (*Ovalipes ocellatus*) | 35 | 0 |
| Greedy columbella (*Anachis avara*) | 28 | 0 |
| Common spider crab (*Libinia emarginata*) | 21 | 3 |
| Blue craw crab (*Callinectes sapidus*) | 11 | 0 |
| Harriss's mud crab (*Rithropanopeus harrissii*) | 10 | 0 |
| Chaneled whelk (*Busycon canaliculatum*) | 7 | 0 |
| Horseshoe crab (*Limulus polyphemus*) | 3 | 0 |
| Sand dollar (*Echinarachnius parma*) | 0 | 3 |
| Bloodworm (*Glycera dibranchiata*) | 2 | 0 |
| Clam worm (*Nereis virens*) | 2 | 0 |
| Grass shrimp (*Crangon septemspinosa*) | 2 | 0 |
| Shore crab (*Sesarma cinereum*) | 1 | 0 |
| Sea cucumber (*Sclerodactyla briareus*) | 1 | 0 |
| Purple sea urchin (*Arabacia punctulata*) | 1 | 0 |

November. Most of the oyster drills (78 per cent) were caught in August and September. All the American lobsters were caught in May, June and July.

Organisms growing on the pots, lines and buoys included barnacles (*Balanus* spp.), the pink hearted hydroid (*Tubularia crocea*) and blue mussels (*Mytilus edulis*). SCUBA divers from the National Marine Fisheries Service noted that, "Sirpulid worms, sponges, mussels and hydroids dominated the epibenthic forms." (Larry Ogren, personal communication).

Only 12 species of invertebrates were caught in the pots at Fire Island reef (Table 2). Starfish clearly dominated the catch (91 per cent). Rock crabs were next in abundance (3 per cent), followed by Jonah crabs (3 per cent), winter shrimp (2 per cent) and American lobster (1 per cent).

Only two showed seasonal variations. Seventy per cent of the starfish and all the winter shrimp were caught in October and November.

Organisms growing on the pots, lines and buoys included barnacles, the pink hearted hydroid and a caprellid (*Caprella penantis*). Shipworms (*Teredo navilis*) riddled the wooden frames of the pots. We saw squid

(*Loligo peali*) caught on rod and reel. A late spring and early summer fishery for American lobster developed each year at Fire Island reef (Briggs and Zawacki, 1974).

## DISCUSSION AND CONCLUSIONS

Kismet reef successfully attracted and held fishes (particularly tautog). In addition, this reef attracted and held many species of invertebrates that may be used by fish as food. However, Kismet reef was often overcrowded with boats in the fall, and expansion of the reef to the full area (994 meters by 46 meters) allowed under permit from the U.S. Army Corps of Engineers might alleviate the crowded conditions.

Likewise, Fire Island reef successfully attracted and held fishes sought by anglers. Fishing pressure appeared to be light at this reef, probably due to its location in the ocean.

The results of this study indicate that artificial reefs in sheltered waters, such as Kismet reef, are far more heavily fished by anglers than are oceanic reefs. For this reason, the author feels that future building of artificial reefs in New York waters might best be directed toward the south shore bays and similar sheltered waters. On the other hand, existing oceanic reefs should not be abandoned. They not only attract fishes that are not regularly found in the south shore bays, but they also attract American lobsters which are harvested by commercial fishermen.

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# EFFECT OF A 4-YEAR CLOSURE OF THE TRAPPING SEASON FOR BEAVER IN EASTERN WARREN COUNTY, NEW YORK[1]

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ABSTRACT

The effect on beaver abundance of closed seasons for trapping from 1965 to 1968 followed by an open season in the spring of 1969 was studied in eastern Warren County, New York. Data were gathered chiefly by aerial censuses of beaver colonies during the fall, supplemented in 1969 by surveys of trapping pressure. The results demonstrated that the beaver population increased during the period it was afforded protection from trapping. On the other hand, it decreased significantly after only one season's trapping.

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During 1964, efforts were made to determine the number of active beaver colonies in the part of Warren County east of the Hudson River. Information was gathered from Bureau of Game personnel, forest rangers, conservation officers and the annual aerial beaver surveys which included portions of the area. The data revealed only 11 known active colonies. It was felt that the beaver population was at a very low level and that trapping was probably responsible. Consequently, the trapping season was closed for four years (1965 to 1968). It was reopened in 1969 when trapping was permitted from March 1 to April 6.

Throughout this period, the status of the beaver population was studied, and in 1969 supplemental observations of trapping pressure were made. The present paper is an evaluation of the findings.

## PROCEDURE

Annual aerial censuses of beaver colonies in eastern Warren County were conducted during the falls of 1965, 1966 and 1967 while trapping was prohibited and in the fall of 1969 after an open season the preceding spring. A census was scheduled for 1968 but had to be cancelled because of other priorities for use of the airplane. The number of potential colony sites in each town was determined from infra-red aerial photographs, as described by Dickinson (1971), for comparison with the number of active colonies observed on the censuses.

During the open season in 1969, information on trapping pressure was obtained by both ground and aerial surveys. Also, reports of pelts tagged were used in evaluating the success of the season. Regulations required that all beaver pelts be brought to a conservation officer and tagged within 5 days after the close of the season, and the officers were in-

[1]A contribution of Federal Aid in Fish and Wildlife Restoration Project W-116-D.

structed to record each pelt according to the county and town where taken.

## FINDINGS

The aerial census data are presented in Table 1 by town. However, the Town of Luzerne was omitted because of its low population level (one active colony in 1965, two in 1966 and two in 1969) and because of a lack of continuous data (it was not included in the 1967 census).

The data for the years when trapping was not permitted show a continued significant increase in the number of colonies for the area as a whole; 21 per cent from 1965 to 1966 and 19 per cent from 1966 to 1967. Two towns had a continuous increase, while one had a continuous decrease. Four of the seven towns registered an increase in 1967 as compared with 1965.

In 1969, after the open season, the number of active colonies had decreased by 15 (27 per cent) as compared with that in 1967. Five towns showed a reduction, while in two the number remained the same. The total in 1969 represented two more colonies than had been observed in 1965.

The number of active colonies per potential site varied considerably (Table 1), as did the number of potential sites per square mile. In 1967, the level of occupancy of potential sites reached 41 per cent in the Town of Hague, while it was only 10 per cent in the Towns of Bolton and Lake George. These figures compared with 21 per cent for the entire area.

An aerial survey of parts of the Towns of Hague and Horicon during the 1969 open season revealed that at least 19 of 25 beaver colonies were being trapped. Ground checks indicated that nearly all colonies were being trapped by more than one trapper, often by several.

The number of beaver taken in eastern Warren County in 1969, as derived from pelt-tagging records, totalled 131 (Table 2). It should be noted that figures are not available for the years immediately prior to 1965 since at that time it was not required that the pelts be tagged.

## DISCUSSION

As pointed out earlier, there were large variations between towns with respect to increases or decreases in the number of beaver colonies. It is believed that these inconsistencies may, at least in part, be attributed to the pattern of illegal trapping. Several instances were reported where evidence of trapping for beaver prior to the season was found. Also, several trappers reported catching beaver during this season that had a foot missing. Most of these beaver were not old enough (judging from pelt size) to have been alive during the last previous open season. How significant illegal trapping was is unknown, but it must be considered as a factor.

Table 1. Number of Active Beaver Colonies Observed During Fall Aerial Censuses, Together With Data Pertaining to Potential Colony Sites, in Eastern Warren County, 1965–1969

| Town | Total land area* | Potential colony sites§ | | Active colonies | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1965 | | 1966 | | | 1967 | | | 1969 | | |
| | | Number | Number per square mile | Number | Number per potential site | Number | Change† | Number per potential site | Number | Change† | Number per potential site | Number | Change† | Number per potential site |
| Bolton | 63.5 | 30 | 0.47 | 2 | 0.07 | 3 | 50 | 0.10 | 3 | 0 | 0.10 | 2 | −33 | 0.07 |
| Chester | 87.3 | 67 | 0.77 | 14 | 0.21 | 16 | 14 | 0.24 | 14 | −13 | 0.21 | 10 | −29 | 0.15 |
| Hague | 64.9 | 29 | 0.45 | 7 | 0.24 | 9 | 29 | 0.31 | 12 | 33 | 0.41 | 12 | 0 | 0.41 |
| Horicon | 66.9 | 70 | 1.05 | 8 | 0.11 | 14 | 75 | 0.20 | 20 | 43 | 0.29 | 13 | −35 | 0.19 |
| Lake George | 28.9 | 10 | 0.35 | 1 | 0.10 | 1 | 0 | 0.10 | 1 | 0 | 0.10 | 1 | 0 | 0.10 |
| Queensbury | 64.6 | 20 | 0.31 | 3 | 0.15 | 2 | −33 | 0.10 | 1 | −50 | 0.05 | 0 | −100 | 0.00 |
| Warrensburg | 67.5 | 44 | 0.65 | 4 | 0.09 | 2 | −50 | 0.05 | 5 | 150 | 0.11 | 3 | −40 | 0.07 |
| Total | 443.6 | 270 | 0.61 | 39 | 0.14 | 47 | 21 | 0.17 | 56 | 19 | 0.21 | 41 | −27 | 0.15 |

* In square miles. Figures from Special Report on Municipal Affairs (New York State Comptroller, 1961); defines land area as dry land and land temporarily under water; excludes permanent inland water surfaces of over 40 acres and streams over ⅛ mile wide.
§ As defined by Dickinson (1967).
† Percentage change from preceding year's colony count.

Table 2. Beaver Pelts Tagged From Eastern Warren County

| Town | 1956 | 1957 | 1958 | 1969 |
|---|---|---|---|---|
| Bolton | 3 | 10 | 19 | 14 |
| Chester | 8 | 19 | 13 | 31 |
| Hague | 1 | 10 | .. | 13 |
| Horicon | 7 | 54 | 4 | 65 |
| Queensbury | 4 | 7 | 2 | 8 |
| Warrensburg | 18 | 8 | 30 | .. |
| Total | 41 | 108 | 68 | 131 |

It is recognized that aerial censuses of beaver colonies are subject to some error. In the present study, instances were reported in which colonies had been missed, with bank colonies being missed most frequently. On occasion, colonies were counted as active that, when investigated on the ground, were found to be inactive.

The results of the three aerial censuses while the season was closed indicate that a significant buildup occurred in the beaver population in eastern Warren County generally. However, on the basis of the number of colonies per potential site, the data indicate that room for population increases existed. The observations in 1965 showed that only 14 per cent of the potential sites were occupied. By 1967 the proportion had increased to 21 per cent. In the Town of Hague, the degree of occupancy of potential sites was 24 per cent in 1965 and increased to 41 per cent by 1967. It is indicated that the beaver population was below the carrying capacity of the area prior to closure of the trapping season, as witnessed by the continued increase in the number of colonies after the closure. It would appear that trapping was indeed a controlling factor.

It is recognized that counts of active colonies do not necessarily provide a true measure of a beaver population. It is possible that, due to behavioral patterns and family structures among beaver, populations could double without any increase in colony count, or colony counts could double with only a slight increase in population. Whenever kits are born, there is a population increase without an immediate increase in colony count. The 21 per cent increase from 1965 to 1966 in the number of colonies observed could have reflected a much greater population increase. Also, the reduction in colony count after the 1969 trapping season may have reflected a much larger population reduction, since colonies which had some, but not all, beaver removed still remained active. However, the average annual increase of 20 per cent in colony count from 1965 to 1967 while trapping was prohibited must be considered significant.

It is unfortunate that no aerial census was made in 1968, the last year of the period when trapping was prohibited. If the population increased from 1967 to 1968 at the same rate as the average (20 per cent) for

the two previous years, the number of colonies in 1968 would have been 67. The reduction from 1968 to 1969 would then have been 39 per cent compared with the 27 per cent recorded from 1967 to 1969. In either case, the reduction in colony count must be interpreted to reflect a substantial decrease in the beaver population, presumably caused by trapping.

While the proportion of potential colony sites actually occupied provides an index of the relationship between a beaver population and the carrying capacity of its range, it does not measure actual population density. Data on the number of potential sites per square mile afford a means of determining such densities. The potential sites per square mile for the towns studied, as derived from interpretation of aerial photographs, varied from 0.31 to 1.05 (Table 1). It is felt that photo-interpretation can provide a valuable index to beaver potential in a given area.

Observations during the spring of 1969 showed that trapping pressure was heavy. At least 75 per cent of the colonies were being trapped, most by more than one trapper. At one colony in the Town of Horicon, 14 traps, all set at the same time, were noted.

A total of 131 beaver pelts from the towns studied were tagged (Table 2). This take was higher than that in 1956, 1957 or 1958. Based on the projected colony count of 67 in 1968, the harvest amounted to approximately two beaver per colony.

## CONCLUSIONS

The beaver population in eastern Warren County increased during the period it was afforded protection from trapping. On the other hand, it decreased significantly after only one season's trapping. More knowledge is needed regarding aerial surveys as a beaver-census technique, the relationship of beaver colonies to available colony sites and the regulation of trapping in managing beaver populations.

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# TOXICITY OF TWO SYNTHETIC PYRETHRINS TO BROWN TROUT[1]

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ABSTRACT

The toxicity of two synthetic pyrethrins, SBP 1382 EC (24.3 per cent active ingredient) and Formula 7067 (5 per cent active ingredient) was determined for fingerling brown trout. By bioassay, it was found that the 24-hour $TL_m$ for SBP 1382 EC was approximately 1.2 micrograms per liter and that the 24-hour and 48-hour $TL_m$ for Formula 7067 were 4.9 and 3.5 micrograms per liter, respectively. Data also indicated that there was a breakdown of SBP 1382 EC when mixed with acetone in stock solutions and kept for more than 24 hours.

A synthetic pyrethrin (SBP 1382 EC, 24.3 per cent active ingredient) has been manufactured[2] for possible use as an insecticide. A search of the literature revealed that it had been tested as a mothproofing agent against the black carpet beetle and larvae of the webbing clothes moth (Lang and Bly, 1971), the results indicating that it could be used as a short-term protective against these insects. It has also been suggested as a possible insecticide for use against the gypsy moth. Brooks et al. (1969) found that, for rats, the acute oral $LD_{50}$ value ranged from 1,500 to 10,200 milligrams per kilogram and that the acute dermal $LD_{50}$ was 3,040 milligrams per kilogram. Since the $LD_{50}$ for rats of natural pyrethrin is 200 milligrams per kilogram (Thompson, 1967), it would appear that the synthetic product is less toxic than the natural material, at least to mammals. Although no data could be found regarding the toxicity of the synthetic pesticide for fish, Cope (1963) stated that the 24-hour $LC_{50}$ of natural pyrethrin was 56 micrograms per liter at 55° F. for rainbow trout and 96 micrograms per liter at 75° F. for channel catfish. Also, Formula 7067 is being developed[3] as a possible insecticide, but nothing could be found in the literature regarding its toxicity to fish. Therefore, it was decided to test the new synthetic products for comparison with natural pyrethrin.

Bioassay procedures used were those described by Doudoroff et al. (1951). Test animals were fingerling brown trout (*Salmo trutta*) from

[1]The authors are indebted to George E. Burdick, former Chief of the Bureau of Ecological Standards and now retired, for assistance in preparing this paper.

[2]S. B. Penick & Co., Jersey City, N.J.

[3]McLaughlin, Gormley King Co., 1715 Southeast 5th Street, Minneapolis, Minn.

one of the New York State fish hatcheries. They averaged 74 millimeters in length in the tests of SBP 1382 EC and 45 millimeters in the tests of Formula 7067. All test fish were acclimatized for at least 1 week under conditions similar to those under which the tests were to be performed. Mortality throughout the testing period was less than 10 per cent, and the fish were not fed for at least 3 days before testing.

Rome Hatchery spring water was used throughout the study. A complete chemical anaylsis of this water was given by Burdick et al. (1954). Test temperatures were 52±1° F. in the tests of SBP 1382 EC and 50±1° F. in the tests of Formula 7067. All bioassays were conducted in 20-liter round glass battery jars filled to a volume of 16 liters and placed in constant-temperature bioassay tanks. Dissolved oxygen was determined at the start and end of each bioassay, and at no time did this value fall below 5.0 ppm.

Stock solutions of each synthetic product were prepared by dissolving the material in either acetone or 95 per cent grain alcohol to a volume of 100 milliliters in a glass-stoppered volumetric flask to make a solution of 1,000 micrograms per liter. For SBP 1382 EC, two sets of bioassays were conducted, one using acetone as the solvent and the other using alcohol, but only acetone was used for Formula 7067. All stock solutions of acetone were made up fresh just prior to testing because there was an indication in the initial tests that a breakdown of the chemical occurred when a solution was kept for more than 24 hours.

Bioassays were made at different concentrations of the stock solution. Each was conducted by placing several test fish in 16 liters of the test solution and noting the survival after 24 hours, and also after 48 hours in the case of Formula 7067. For SBP 1382 EC, five fish were used in each instance, and the test was repeated four times to give a total of 20 fish at each concentration except for those at 1.55 and 0.77 micrograms per liter which had only 15 and 10, respectively. For Formula 7067, 10 fish were used in each instance, and the test was repeated twice for a total of 20 fish at each concentration.

The results of the tests with SBP 1382 EC are summarized in Table 1. The pattern of survival in relation to concentration of the chemical was approximately the same for both solvents. Although the 24-hour $TL_m$ was not actually observed, it can be derived by plotting the percentage survival against the test concentration on semi-log two-cycle graph paper (Figure 1) as described by Doudoroff et al. (1951). The values for the two solvents intersect at about the 50 per cent level of survival which represents approximately 1.20 micrograms per liter (ppb). Therefore, it was deemed unnecessary to conduct further bioassays to determine the exact 24-hour $TL_m$ of this material by observation.

As stated earlier, initial tests indicated that the toxicity of SBP 1382 EC dissolved in acetone decreased after the stock solution had been

Table 1. Survival of Fingerling Brown Trout Exposed to the Synthetic Pyrethrin SBP 1382 EC* At Different Concentrations of Stock Solution According to the Solvent Used

| Concentration§ | Test fish: Number per test | Test fish: Replications | Test fish: Total | Temperature (° F.) | Dissolved oxygen (ppm) | 24-hour survival (per cent) |
|---|---|---|---|---|---|---|
| Stock solution made with alcohol | | | | | | |
| 2.96 | 5 | 4 | 20 | 52 | 8.2 – 6.6 | 0 |
| 1.23 | 5 | 4 | 20 | 52 | 8.2 – 6.8 | 0 |
| 1.18 | 5 | 4 | 20 | 52 | 8.0 | 85 |
| 1.10 | 5 | 4 | 20 | 52 | 8.0 – 5.8 | 80 |
| 0.98 | 5 | 4 | 20 | 52 | 8.4 | 95 |
| Stock solution made with acetone | | | | | | |
| 4.94 | 5 | 4 | 20 | 52 | 9.0 – 8.0 | 0 |
| 1.98 | 5 | 4 | 20 | 52 | 9.4 – 6.4 | 0 |
| 1.55 | 5 | 3 | 15 | 52 | 9.6 – 6.8 | 0 |
| 0.98 | 5 | 4 | 20 | 52 | 9.8 | 85 |
| 0.77 | 5 | 2 | 10 | 52 | 9.4 – 6.4 | 100 |

* 24.3 per cent active ingredient.
§ In micrograms per liter.

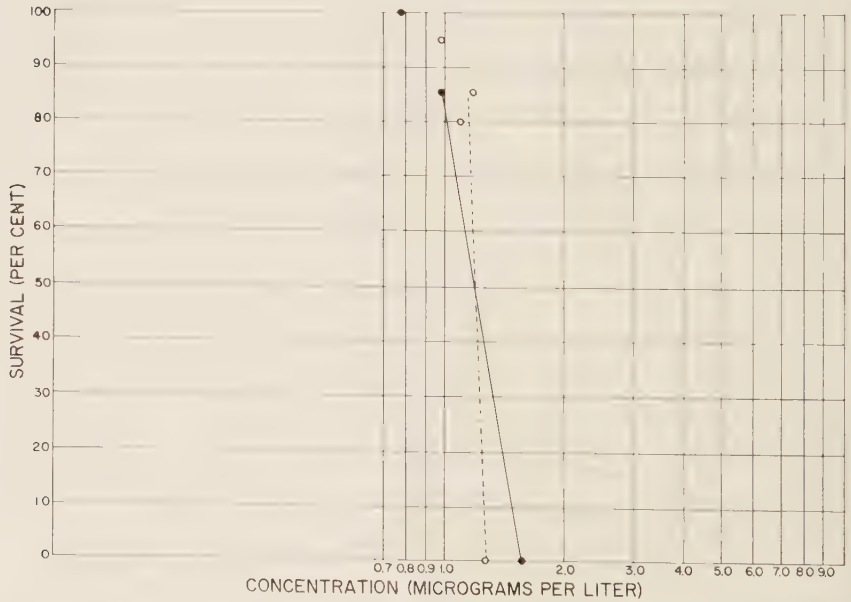


Figure 1. Relationship of survival to concentration for fingerling brown trout exposed to the synthetic pyrethrin SBP 1382 EC according to the solvent used. Solid circles represent acetone; open circles, alcohol.

TABLE 2. SURVIVAL OF FINGERLING BROWN TROUT EXPOSED TO THE SYNTHETIC PYRETHRIN SBP 1382 EC* AT DIFFERENT CONCENTRATIONS OF STOCK SOLUTION MADE WITH ACETONE ACCORDING TO AGE OF SOLUTION AT TIME OF TEST

| Stock solution | | Test fish | | | Temperature (° F.) | Dissolved oxygen (ppm) | Survival (per cent) | | |
|---|---|---|---|---|---|---|---|---|---|
| Concentration§ | Age (days)† | Number per test | Replications | Total | | | 24-hour | 48-hour | 96-hour |
| 2.96†† | 12 | 5 | 4 | 20 | 52 | 9.0 – 6.2 | 100 | 85 | 85 |
| 1.98‡ | 6 | 5 | 4 | 20 | 52 | 9.0 – 5.0 | 65 | 65 | 55 |
| 1.23 | 2 | 5 | 4 | 20 | 52 | 9.0 | 100 | 95 | .. |

* 24.3 per cent active ingredient.
§ In micrograms per liter.
† Elapsed time, at time of test, since solution had been prepared.
†† Solution changed after 24 hours.
‡ Solution changed after 48 hours.

TABLE 3. SURVIVAL OF FINGERLING BROWN TROUT EXPOSED TO THE SYNTHETIC PYRETHRIN FORMULA 7067* AT DIFFERENT CONCENTRATIONS OF STOCK SOLUTION MADE WITH ACETONE ACCORDING TO TWO PERIODS OF EXPOSURE

| Concentration§ | Test fish | | | Temperature (° F.) | Dissolved oxygen (ppm) | Survival (per cent) |
|---|---|---|---|---|---|---|
| | Number per test | Replications | Total | | | |
| 24-hour exposure | | | | | | |
| 10.0 | 10 | 2 | 20 | 50 | 10.2 – 7.0 | 0 |
| 6.5 | 10 | 2 | 20 | 50 | 10.0 – 6.6 | 0 |
| 5.6 | 10 | 2 | 20 | 50 | 10.2 – 8.0 | 30 |
| 4.2 | 10 | 2 | 20 | 50 | 10.2 – 8.0 | 75 |
| 3.7 | 10 | 2 | 20 | 50 | 10.0 – 7.4 | 80 |
| 3.2 | 10 | 2 | 20 | 50 | 10.2 – 8.0 | 95 |
| 1.8 | 10 | 2 | 20 | 50 | 10.2 – 7.6 | 100 |
| Control† | 10 | 2 | 20 | 50 | 9.6 – 7.4 | 100 |
| 48-hour exposure | | | | | | |
| 6.5 | 10 | 2 | 20 | 50 | 10.0 – 6.6 | 0 |
| 5.6 | 10 | 2 | 20 | 50 | 10.2 – 6.6 | 5 |
| 4.2 | 10 | 2 | 20 | 50 | 10.2 – 7.8 | 0 |
| 3.7 | 10 | 2 | 20 | 50 | 10.0 – 7.2 | 40 |
| 3.2 | 10 | 2 | 20 | 50 | 10.2 – 7.4 | 85 |
| 1.8 | 10 | 2 | 20 | 50 | 10.2 – 6.6 | 100 |
| Control† | 10 | 2 | 20 | 50 | 9.6 – 5.8 | 100 |

* 5 percent active ingredient.
§ In micrograms per liter.
† Control solution containing 10,000 ppm of acetone used to insure that no mortality was occurring from this solvent.

kept for more than a day. The data (Table 2), when compared with those in Table 1, show that more than 50 per cent of the test fish survived at concentrations that previously had resulted in no survival when fresh stock solutions were used. Thus it seems evident that SBP

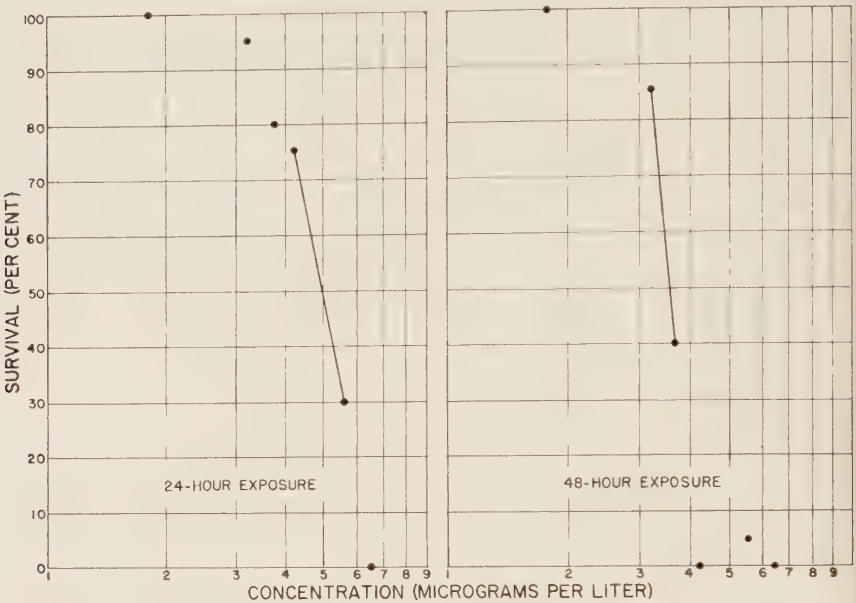


Figure 2. Relationship of survival to concentration for fingerling brown trout exposed to the synthetic pyrethrin Formula 7067 according to two periods of exposure.

1382 EC (24.3 per cent active ingredient) rapidly loses its toxicity when mixed with acetone in stock solution.

It is logical to assume that a similar loss in toxicity occurred in the actual bioasays. This would account for the almost total survival or total loss of test fish as the threshold of toxicity was approached. If there was not enough of the chemical present to cause mortality within the first few hours of bioassay, then the toxicant had probably broken down to a concentration well below the threshold-toxicity value. A flow-through bioassay would resolve this problem, but it was not deemed practical to attempt in this study.

The results of the tests with Formula 7067 are summarized in Table 3. As with the other synthetic pyrethrin, it was shown to be extremely toxic to fingerling brown trout. The data, when plotted (Figure 2), showed a 24-hour $TL_m$ of 4.9 micrograms per liter and a 48-hour $TL_m$ of 3.5 micrograms per liter.

Both of the materials were found to be extremely toxic to fingerling brown trout. As noted earlier, Cope (1963) found that natural pyrethrin had a 24-hour $LC_{50}$ of 56 micrograms per liter at 55° F. for rainbow trout. When this is compared with the data from the present study, it is safe to assume that these two synthetic pyrethrins are more toxic to trout than natural pyrethrin, even when the difference in species is considered. Since SBP 1382 EC breaks down rapidly when mixed in acetone, data on

the rate of this breakdown would be valuable in assessing the effects of this material on non-target organisms as well as on the insect to be controlled.

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# HOODED MERGANSERS BREEDING IN NEW YORK[1]

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ABSTRACT

The geographic distribution of 229 breeding records for the hooded merganser in New York, most of them unpublished, is summarized. They involved 26 counties, but none was from Long Island. There was an average of 9.9 eggs in 34 nests and an average of 5.4 ducklings in 150 broods of all pre-flight ages.

Although the hooded merganser (*Lophodytes cucullatus*) is not a common breeding duck in New York, it does occur in low numbers in many areas of the State. Unfortunately, this is not reflected in the published literature, where only 38 records representing about 44 nests or broods could be found. All the records were in the Kingbird.[2] Eaton (1910) said that the hooded merganser "has been known to breed in the counties of Cayuga, Erie, Jefferson, Ontario, Wayne as well as those of the Catskill and Adirondack regions". Benson (1943) stated "It is found frequently in the Adirondacks and the periphery counties and has reared broods in Erie, Wayne, Cayuga, Cortland, Chenango and Orange Counties." Neither of these accounts gave any specifics about numbers, dates or sources of information.

## METHOD

There are many records of hooded merganser nests and brood observations in the files and unpublished reports of New York's Waterfowl Management Research Project (W-39-R) as a result of nest box and brood surveys conducted in several areas of the State over the last 20 years. The author suspected that similar records were to be found in files of the Department's regional offices and in those of the Iroquois and Montezuma National Wildlife Refuges in upstate New York. These sources were contacted, as were also personnel of the North American Nest-Record Card Program at Cornell University. Also, the published literature relating to New York birds was searched.

The information received from all sources was then listed, and duplicate or possibly duplicate records were removed. In the case of duplicate

[1]A contribution of Federal Aid in Fish and Wildlife Restoration Project W-39-R. The author wishes to express appreciation to Anthony Buzzanco who called the need for publication of this information to his attention and to Department of Environmental Conservation regional wildlife managers and their staffs, Martin Phillips and John Morse of the U.S. Fish and Wildlife Service and Charles Emmerich for searching their files and the published literature to provide data for this paper.

[2]Quarterly publication of the Federation of New York State Bird Clubs, Inc.

records, the one which provided the most detailed or definite information was retained and the other was discarded. The remaining records were then listed by county of occurrence. In the case of the Montezuma National Wildlife Refuge, all records were attributed to Seneca County although a small portion of the refuge is in Cayuga County. Likewise, the Iroquois National Wildlife Refuge and the Oak Orchard and Tonawanda Wildlife Management Areas straddle county boundaries. All the records for these areas were attributed to Genesee County. Some of these were probably in Orleans County but this could not be certainly ascertained from the information available. Brood size and clutch size, when available, were also tabulated. Only nests with eggs and sightings of flightless young birds by competent observers were accepted as proof of breeding.

## FINDINGS

In all, 229 separate breeding records of the hooded merganser were identified. These were distributed over 26 counties (Figure 1). They spanned the period from 1941 to 1973, although most (145) were from the 1960's. There were no breeding records from Long Island.

To some extent, the number of reports from a particular area can be attributed to the amount of activity by people looking for, and recording, ducks rather than to the relative abundance of hooded mergansers. For in-

Figure 1. Number of records per county for nests or broods of the hooded merganser in New York.

stance, there was an annual survey made for ringnecked ducks (*Aythya collaris*) in the Tupper Lake-Saranac Lake area from 1954 through 1969. This survey usually involved four people for five days. All ducks seen were recorded, including the number and approximate age of ducklings in each brood. This survey accounted for all but eight of the 90 records for Hamilton, Essex and Franklin Counties. Similar, though less intensive, activities occurred in Genesee, Cayuga, Saratoga, Seneca, St. Lawrence and Jefferson Counties.

The number of eggs was recorded for 34 nests. There was an average of 9.9 eggs per nest (range: 1-20). The most frequently recorded clutch size was 10 eggs. The range from 9 to 12 eggs accounted for nearly 60 per cent of all the clutches.

The average size for 150 broods was 5.4 ducklings. This should be considered a minimum since in some broods not all the ducklings could be seen. This average included ducklings from 1 day old to near flight stage. Since the age of most ducklings was not recorded, it was not possible to measure pre-flight mortality rates. Likewise, the data did not lend themselves to statistical analysis of the relation of clutch size to brood size or of geographical or temporal differences. Visual examination of the data suggests that broods in the Adirondacks[3] may hatch slightly later and average slightly fewer ducklings per brood than in the rest of the State.

Nesting of the hooded merganser and nesting of the wood duck appear to be synchronous. This is supported by the observation of mixed clutches of eggs. The author has seen one such clutch being incubated by a hooded merganser and one by a wood duck at the Vischers Ferry Wildlife Management Area in Saratoga County. On this same area and a nearby water-supply reservoir, there were four mixed clutches recorded in one year (1961).

Most of the nests reported were located in nest boxes erected for wood ducks in drowned timber or along the wooded margins of ponds. Hooded mergansers are welcome tenants in such boxes, and perhaps more boxes in wooded, undisturbed situations will eventually lead to higher populations of this beautiful duck.

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[3] Franklin, Hamilton and Essex Counties.

# NOTES ON THE BIOLOGY AND FOOD HABITS OF THE CUNNER[1]

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ABSTRACT

During the summer of 1971, 500 cunners (*Tautogolabrus adspersus*) ranging from 61 to 200 millimeters in standard length were collected from the Sakonnet River at Portsmouth, Rhode Island. The fish were examined for meristic characters, length-weight relationships and food habits. The data indicated that the cunner is omnivorous but that the majority of its food is animal material. Various species of algae were found in the alimentary tracts examined. *Balanus balanoides, Mytilus edulis* and *Mya arenaria* dominated the food, both in occurrence and volume. *Bugula* sp. also contributed greatly in terms of occurrence, but it was low in volume.

The cunner (*Tautogolabrus adspersus*) is one of two species of fish of the family Labridae inhabiting New England coastal waters, the other being the tautog (*Tautoga onitis*). The cunner ranges generally from Newfoundland to Virginia and is found mainly around piers, pilings, rockpiles and wrecks as well as in kelp and grass beds (Hildebrand and Schroeder, 1928; Bigelow and Schroeder, 1953; Serchuk and Frame, 1973). While once somewhat important commercially, the cunner is presently not sought by commercial fishermen. However, it makes up a significant portion of the catch of many sports fishermen (Serchuk and Frame, 1973). This note presents data on certain meristic characters of *T. adspersus,* as well as length-weight relationships and food habits of specimens collected in the vicinity of Portsmouth, Rhode Island.

## MATERIALS AND METHODS

During the summer of 1971, 500 cunners were collected from the Sakonnet River at Portsmouth, Rhode Island (Figure 1). All the fish were captured by rod and reel using cut *Mya arenaria* and *Nereis virens* as bait. Immediately following capture, each fish was sexed, weighed to the nearest 0.1 gram and measured to the nearest millimeter (both in standard length and total length), and meristic determinations were made on the dorsal, anal, pectoral and pelvic fins. The gill raker count on the lower limb of the first arch was made on each fish. Because the cunner does not possess a morphological stomach (Chao, 1973), the

[1]Appreciation is expressed to Dr. Gilbert W. Bane of St. Francis College for advice and encouragement in this work and to Dr. Howard Reisman of Southampton College and Dr. Herbert Austin of the New York Ocean Science Laboratory for reviewing the manuscript.

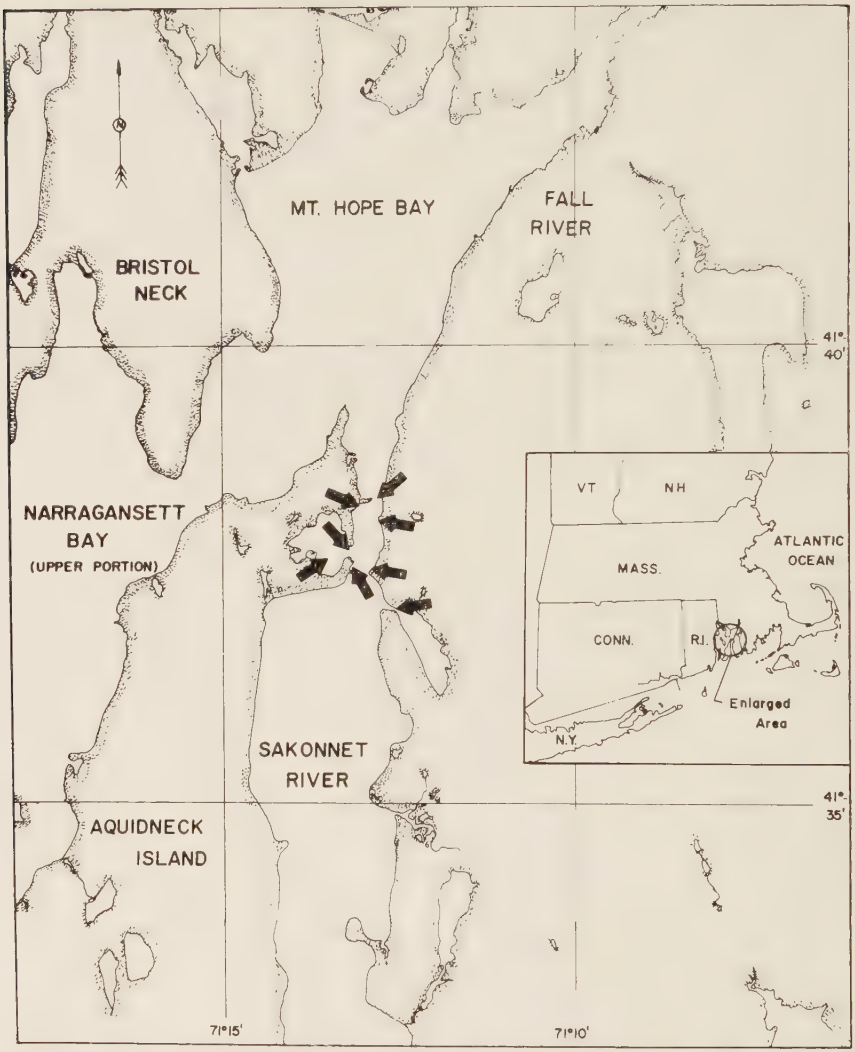


Figure 1. Map showing location of study area and enlargement with sampling stations indicated by arrows.

alimentary tracts were removed for food habits studies. The alimentary tracts were preserved in 10 per cent formalin until they could be examined in the laboratory.

Food habits analyses consisted of identifying the organisms found in each digestive tract and determining their volume. Enumeration of individual organisms was not always possible since many of the food items were crushed during either ingestion or digestion (e.g., *Balanus balanoides, Mytilus edulis, Mya arenaria*), existed as colonies (e.g., *Bugula* sp.) or were multicellular (e.g., various species of algae).

Length-weight reationships were obtained from the formula $Y=ax^b$, where $Y$ is the length (either standard or total) in millimeters, $x$ is the weight in grams, and $a$ and $b$ are constants.

## RESULTS AND DISCUSSION

Meristic determinations on the dorsal, anal, pectoral and pelvic fin rays are presented in Table 1. The greatest variability was observed in the dorsal ray counts, including both soft and hard rays, although for each type of fin one particular count dominated in excess of 90 per cent of the 500 fish examined. The dominant counts were: XVIII, 10 for the dorsal; III, 9 for the anal; 14 for the pectoral; and 6 for the pelvic fin rays. No variability was observed in the pelvic ray counts.

Table 1. Meristic Characters of 500 Cunners From the Sakonnet River at Portsmouth, Rhode Island

| Character | Number | Percentage of specimens |
|---|---|---|
| Dorsal fin rays | XVIII, 8 | 0.4 |
| | XVIII, 9 | 2.2 |
| | XVIII, 10 | 96.2 |
| | XVI, 9 | 0.2 |
| | XIX, 9 | 0.6 |
| Anal fin rays | III, 7 | 0.2 |
| | III, 8 | 0.6 |
| | III, 9 | 99.2 |
| Pectoral fin rays | 14 | 99.2 |
| | 15 | 0.8 |
| Pelvic fin rays | 6 | 100.0 |

Jordan and Evermann (1896) listed dorsal and anal ray counts for *T. adspersus* as XVIII, 10 and III, 9, respectively, but they included no figures on the variability to be expected. Bigelow and Schroeder (1953) reported the dorsal fin of *T. adspersus* as having "about 18 spines and 9 or 10 soft rays" and the anal fin as having "3 stout spines and about 9 rays". Hildebrand and Schroeder (1928) found dorsal ray counts of XVIII, 9 and anal ray counts of III, 8 on a single cunner they examined from Chesapeake Bay. None of these authors presented information on the number of pectoral or pelvic fin rays.

Gill raker counts of the lower limb of the first arch indicated a range of 9 to 12. The majority of the fish (79.8 per cent) had 11 gill rakers on the lower limb, but 0.4 per cent had nine, 9.0 per cent had 10, and 10.8 per cent had 12 gill rakers. Jordan and Evermann (1896) reported that 11 gill rakers was the predominant number for the specimens they examined.

Length-weight relationships are presented in Table 2. The curves

Table 2. Length-weight Relationships For 500 Cunners From the Sakonnet River at Portsmouth, Rhode Island

| Relationship and equation* | Value of $r$ |
|---|---|
| Standard length-weight (n=500 fish) $Y=0.000067\ X^{2.815437}$ | 0.95893 |
| Total length-weight (n=500 fish) $Y=0.000016\ X^{3.007439}$ | 0.97742 |
| Standard length-weight (n=297 males)§ $Y=0.000093\ X^{2.746324}$ | 0.95741 |
| Standard length-weight (n=199 females)§ $Y=0.000052\ X^{2.875636}$ | 0.95565 |

* See text for description of equation.
§ Number of males plus number of females is less than 500 because sex was not determined for four individuals.

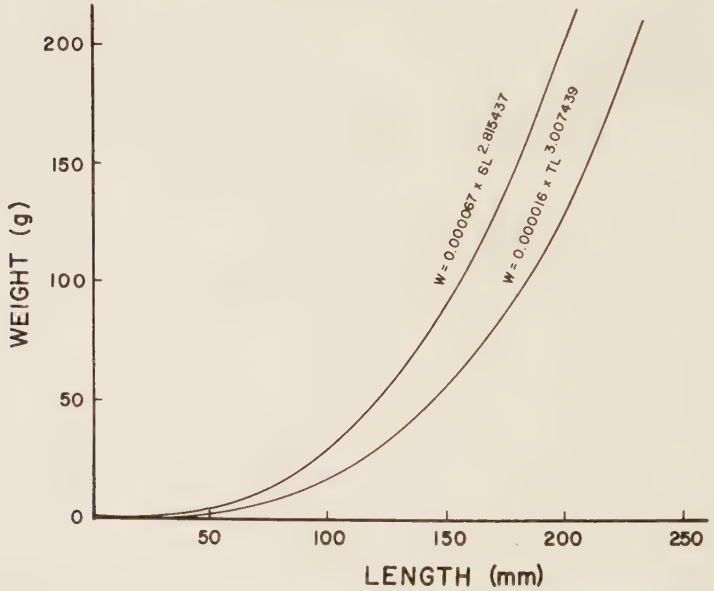


Figure 2. Relationship of weight to total length and standard length for 500 cunners from the Sakonnet River at Portsmouth, Rhode Island.

derived for the relationship of standard length to weight and of total length to weight, for all 500 specimens, are shown in Figure 2. Separate curves for males and females (which were based on standard length) are not included since many of the points were nearly concurrent with those for all fish. Because of the similarity in the three curves calculated on standard length, there is no reason to consider sex when determining weight on the basis of standard length, at least in the size range of the fish examined (i.e., 60 to 200 millimeters). The distribution of the fish

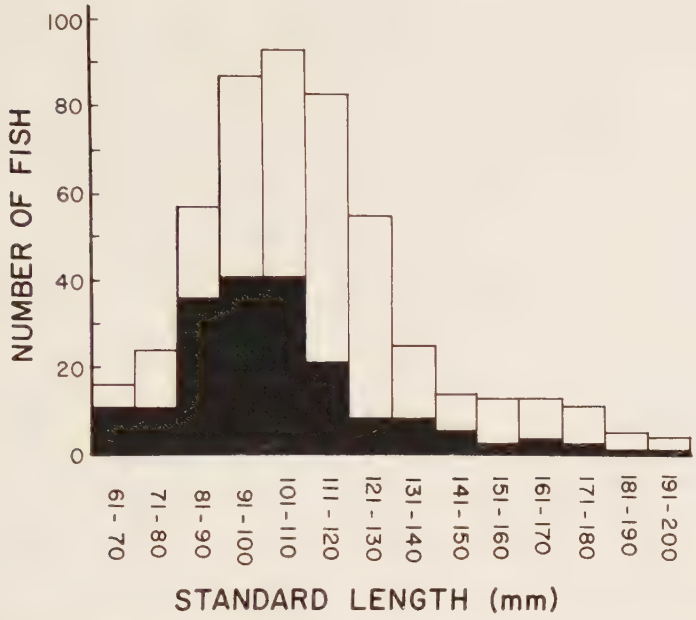


Figure 3. Length-frequency distribution, according to standard length, of 500 cunners from the Sakonnet River at Portsmouth, Rhode Island. Shaded portion indicates specimens with no food in alimentary tract.

collected was nearly normal (Figure 3), although skewed toward the smaller sizes because of failure to collect individuals less than 60 millimeters long by rod and reel.

Bigelow and Schroeder (1953) reported that adult cunners from the Gulf of Maine generally range from 6 to 10 inches (144-254 millimeters) in length with a maximum of about 15 inches (381 millimeters). The largest fish obtained in this study was 198 millimeters in standard length (251 millimeters in total length) and was thus within the norm for adults as given by Bigelow and Schroeder.

The food habits of the cunner have been discussed by various authors, including: Bigelow and Schroeder (1953); Chao (1973); Dexter (1947); Hildebrand and Schroeder (1928); Johansen (1925); Nichols and Breder (1927); Osburn (1921); and Richards (1963a, 1963b). Most authors agree that the cunner is omnivorous, although the preponderance of its food appears to be mollusks and crustaceans. Chao (1973), in a study of the morphology of the alimentary canal of *T. adspersus* and the food habits of specimens collected from the coastal waters of Massachusetts, concluded that the cunner is primarily carnivorous even though some plant material was often associated with the contents of the alimentary tract.

Of the 500 digestive tracts examined during the present study, 309

Table 3. Food Organisms Found in the Alimentary Tracts of 500 Cunners From the Sakonnet River at Portsmouth, Rhode Island, and Their Occurrence By Frequency and Volume

| Organism | Specimens containing organism | | Volume (per cent) § |
|---|---|---|---|
| | Number | Per cent* | |
| Algae | | | |
| *Ulva lactuca* | 11 | 3.5 | 1.3 |
| *Fucus vesiculosus* | 9 | 2.9 | 1.6 |
| *Laminaria saccharina* | 5 | 1.6 | 0.6 |
| *Porphyra* sp. | 2 | 0.6 | 0.2 |
| *Chondrus crispus* | 2 | 0.6 | 0.2 |
| *Ceramium rubrum* | 2 | 0.6 | 0.2 |
| Unidentified | 5 | 1.6 | 0.4 |
| Porifera | | | |
| *Microciona prolifera* | 7 | 2.3 | 0.5 |
| Unidentified | 1 | 0.3 | 0.1 |
| Coelenterata | | | |
| *Tubularia crocea* | 6 | 1.9 | 0.6 |
| *Metridium* sp. | 13 | 4.2 | 2.0 |
| Annelida | | | |
| *Nereis virens* | 14 | 4.5 | 2.4 |
| Arthopoda | | | |
| *Balanus balanoides* | 147 | 47.6 | 38.8 |
| *Gammarus* sp. | 7 | 2.3 | 0.6 |
| *Palaemonetes pugio* | 1 | 0.3 | 0.1 |
| *Neopanope texana sayi* | 17 | 5.5 | 3.4 |
| *Uca* sp. | 3 | 1.0 | 1.4 |
| *Libinia emarginata* | 1 | 0.3 | 0.4 |
| Unidentified macruran | 2 | 0.6 | 0.9 |
| Unidentified brachyuran | 2 | 0.6 | 0.7 |
| Mollusca | | | |
| *Mytilus edulis* | 30 | 9.7 | 9.0 |
| *Modiolus demissus plicatulus* | 8 | 2.6 | 1.7 |
| *Mercenaria mercenaria* | 1 | 0.3 | 0.8 |
| *Mya arenaria* | 34 | 11.0 | 16.3 |
| *Littorina litorea* | 10 | 3.2 | 1.4 |
| *Eupleura caudata* | 7 | 2.3 | 0.9 |
| Unidentified gastropod | 3 | 1.0 | 0.2 |
| Ectoprocta | | | |
| *Bugula* sp. | 26 | 8.4 | 3.9 |
| Unidentified | 1 | 0.3 | 0.1 |
| Chordata—Ascidiacea | | | |
| *Molgula manhattensis* | 14 | 4.5 | 2.4 |
| Chordata—Osteichthys | | | |
| *Menidia menidia* | 13 | 4.2 | 5.7 |
| *Fundulus majalis* | 2 | 0.6 | 0.5 |
| *Tautogolabrus adspersus* | 1 | 0.3 | 0.6 |

* Based on the 309 specimens that contained food.
§ Based on total food volume of 221.8 milliliters.

contained food. The food organisms identified, together with their frequency of occurrence and volume, are presented in Table 3. Considering only the specimens that contained food, the organisms that occurred

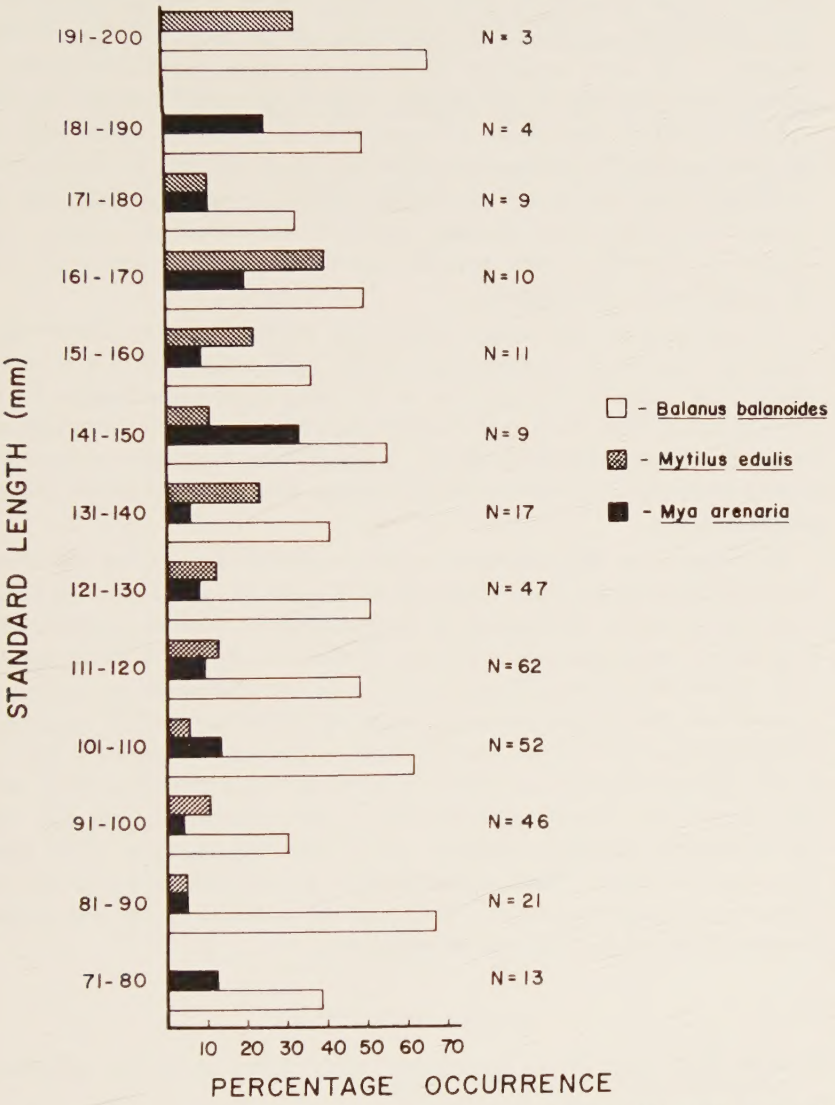


Figure 4. Percentage occurrence of *Balanus balanoides, Mytilis edulis* and *Mya arenaria* in the alimentary tracts of cunners from the Sakonnet River at Portsmouth, Rhode Island, according to the size of the fish in standard length.

most often were the barnacle *Balanus balanoides* (47.6 per cent), the mussel *Mytilus edulis* (9.7 per cent), the clam *Mya arenaria* (11.0 per cent) and the ectoproct *Bugula* sp. (8.4 per cent). These four species accounted for 68.0 per cent of the total volume of food material re-

covered. Algae of several species were found in 36 of the specimens (11.7 per cent) and represented 4.5 per cent of the total volume of food material. Fish were found in 16 specimens, three species being represented one of which was the cunner itself (a juvenile). Of the 16 individuals found as food items, 13 were *Menidia menidia,* which may reflect the availability of that species rather than selection by the cunner. Although there was a general parallel in the relative rankings of the various food organisms, whether based on occurrence or volume, the values for occurrence were usually higher because many specimens had taken more than one organism.

The findings of this study corroborate those of other authors that, while the cunner is omnivorous, mollusks and arthropods are its chief foods. The cunner also appears to be somewhat opportunistic in its feeding habits, but whether it is able to benefit nutritionally from algae is uncertain. Algae and other plant materials may be taken incidentally during primarily carnivorous feeding. Many attached forms were among the foods taken.

The data were also examined to determine whether any of the three major food items (*B. balanoides, M. edulis* and *M. arenaria*) was taken to a greater degree by cunners of one size than by those of another. The relationship based on standard length is shown in Figure 4. With respect to *B. balanoides,* there did not appear to be any preference by cunner of a particular size; it was present in excess of 30 per cent of all specimens examined regardless of size. Although *M. edulis* was absent from fish 71 to 80 millimeters long and from fish 181 to 190 millimeters long, and *M. arenaria* was absent from fish 191 to 200 millimeters long, this was not considered important because of the few specimens of these sizes that were examined. There appeared to be a trend toward an increasing frequency of occurence of *M. edulis* and *M. arenaria* as the size of the cunners increased, but this was not consistent.

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## GENERAL NOTES

### OCCURRENCE OF THE OPOSSUM IN THE CENTRAL ADIRONDACKS

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The opossum (*Didelphis marsupialis virginiana*) began to appear in the area of New York State immediately south of the Mohawk River during the 1930's. By 1937 it was not unusual to see dozens of them killed on the highway in April and May in Albany County. The species spread northward in the Hudson valley, and, to my certain knowledge, road-killed animals have been seen in the vicinity of Lake George Village on the eastern side of the Adirondacks. However, the opossum is rare in the central Adirondacks.

On February 20, 1971 an opossum was found dead on the highway (Route 3) about 5 miles south of Cranberry Lake Village in the Town of Clifton in St. Lawrence County. The animal had been dead only a short time because it was not frozen. How this animal happened to be in the central Adirondacks in mid-winter is unknown. The tip of its tail and the tips of its ears were not frozen back as is so commonly seen in opossums living in upstate New York.